US006364227B1

(12) **United States Patent**
Dorscht

(10) **Patent No.: US 6,364,227 B1**
(45) **Date of Patent: Apr. 2, 2002**

(54) **INTERFACE ELEMENTS FOR SHREDDER MILLS**

(76) Inventor: **John Dorscht**, 69 Georgain Crescent, Kitchener, Ontario (CA), N2B 3N8

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/598,683**

(22) Filed: **Jun. 21, 2000**

(51) **Int. Cl.**[7] **B02C 13/28**
(52) **U.S. Cl.** **241/197**; 241/294
(58) **Field of Search** 241/195, 191, 241/197, 189.1, 294

(56) **References Cited**

U.S. PATENT DOCUMENTS

1,648,747	A		11/1927	Stoner
1,698,758	A		1/1929	Knittel
1,773,408	A		8/1930	Rolfsen
1,946,701	A		2/1934	Knittel
2,143,068	A		1/1939	Hartshorn
2,205,850	A		6/1940	Griesedieck
3,580,518	A		5/1971	Strom
3,591,096	A		7/1971	DeFeo
3,838,826	A	*	10/1974	Wallace et al. 241/294
4,077,573	A		3/1978	Kersey et al.
4,149,677	A		4/1979	Graveman et al.
4,826,090	A	*	5/1989	Orphall 241/195
4,997,136	A		3/1991	Becker
5,114,085	A		5/1992	Inui
5,320,292	A		6/1994	Smith
5,484,111	A		1/1996	Dorscht et al.

* cited by examiner

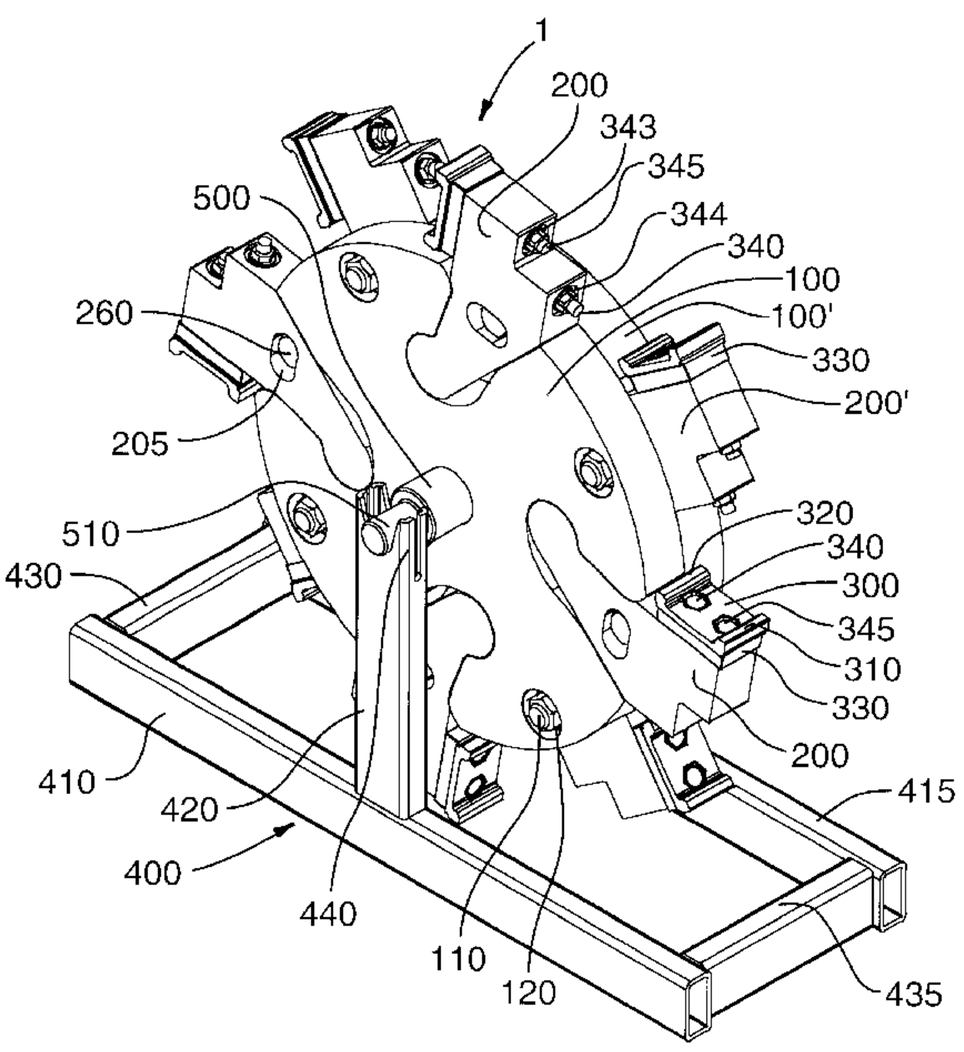
Primary Examiner—Mark Rosenbaum

(74) *Attorney, Agent, or Firm*—R. Craig Armstrong

(57) **ABSTRACT**

An interlocking interchangeable interface element and rotor assembly comprising at least two rotor bodies, a plurality of interface element mounting cut-outs arranged substantially radially in the rotor bodies, a plurality of interface elements arranged to be mountable in the cut-outs and a plurality of peripheral mounting holes arranged to receive rotor body bundling means to hold the rotor bodies fixedly against each-other and to prevent the hammers to exit the interface element mounting cut-outs. Each of the interface elements has a substantially oblong and planar shape; a bottom end shaped to interlock with the cut-outs; a leading edge facing the direction of rotation of the rotors; a trailing edge facing the side opposite to the direction of rotation; and interface element tip mounting means, arranged in an upper mounting portion of each interface element. The interface elements further have a bottom portion with a generally rounded surface arranged to cooperate with a generally rounded bottom portion of the cutouts, a heel portion facing the direction of rotation and shaped to cooperate with a recess portion of the cutouts, so that during insertion of an individual interface element in one cut-out, by inserting the bottom portion first, the generally rounded surface is slidable into a relief recess portion of the cut-outs, permitting the heel portion to clear the protruding portion and the interface element to be seated with the bottom portion in the generally rounded bottom portion of the cut-outs. The individual interface element is thus locked from movement in a radial direction in the rotor bodies. The interface elements further have a first force absorbing surface, arranged on the trailing edge, and a second force absorbing surface, arranged on the leading edge, and interface element securing fasteners, arranged to receive the rotor bundling means for securing the interface elements to the rotor bodies.

13 Claims, 15 Drawing Sheets



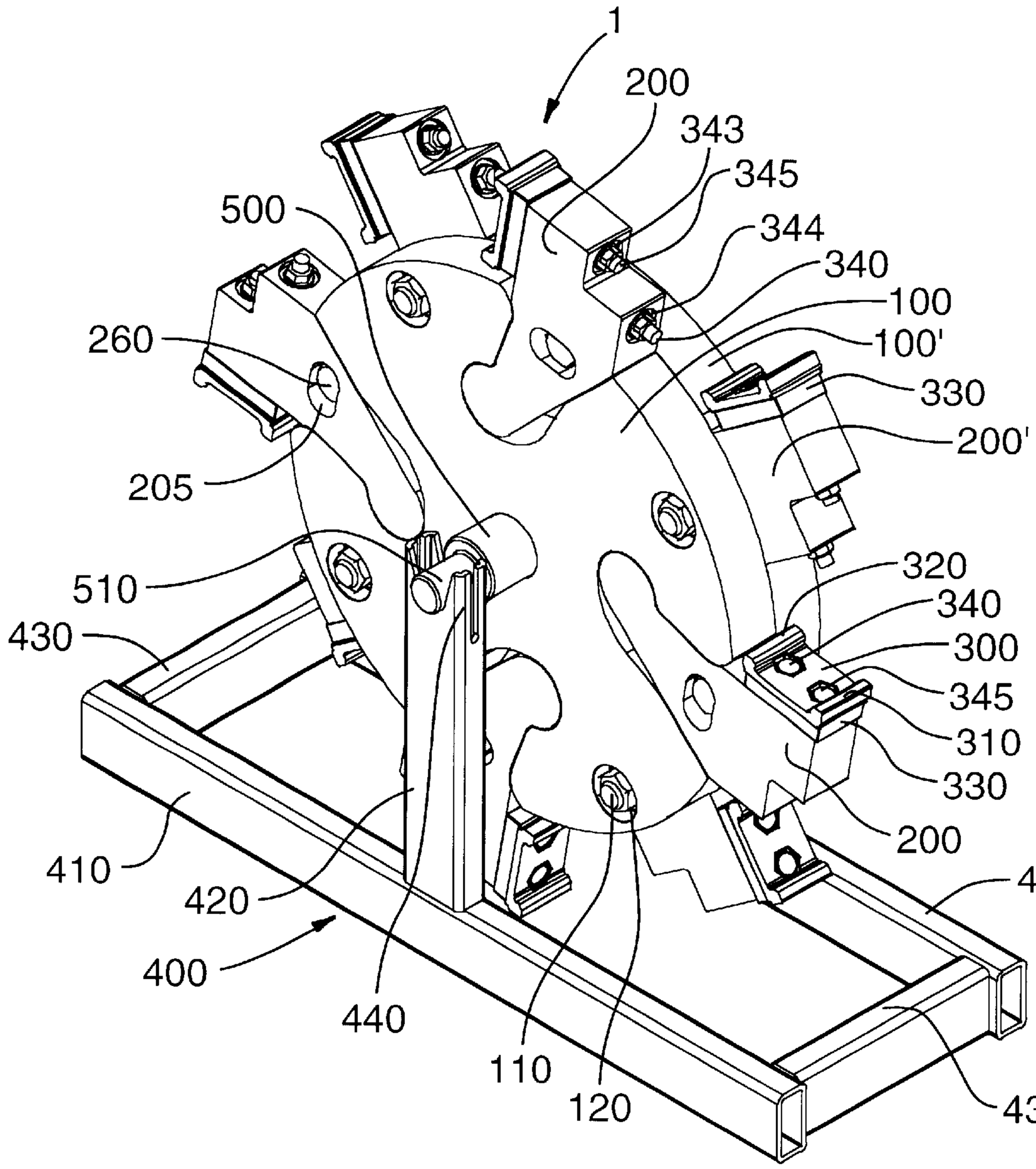

1
200
343
345
500
344
340
100
260
100'
330
200'
205
320
510
340
430
300
345
310
330
200
410
415
420
400
440
110
120
435

FIG.1A

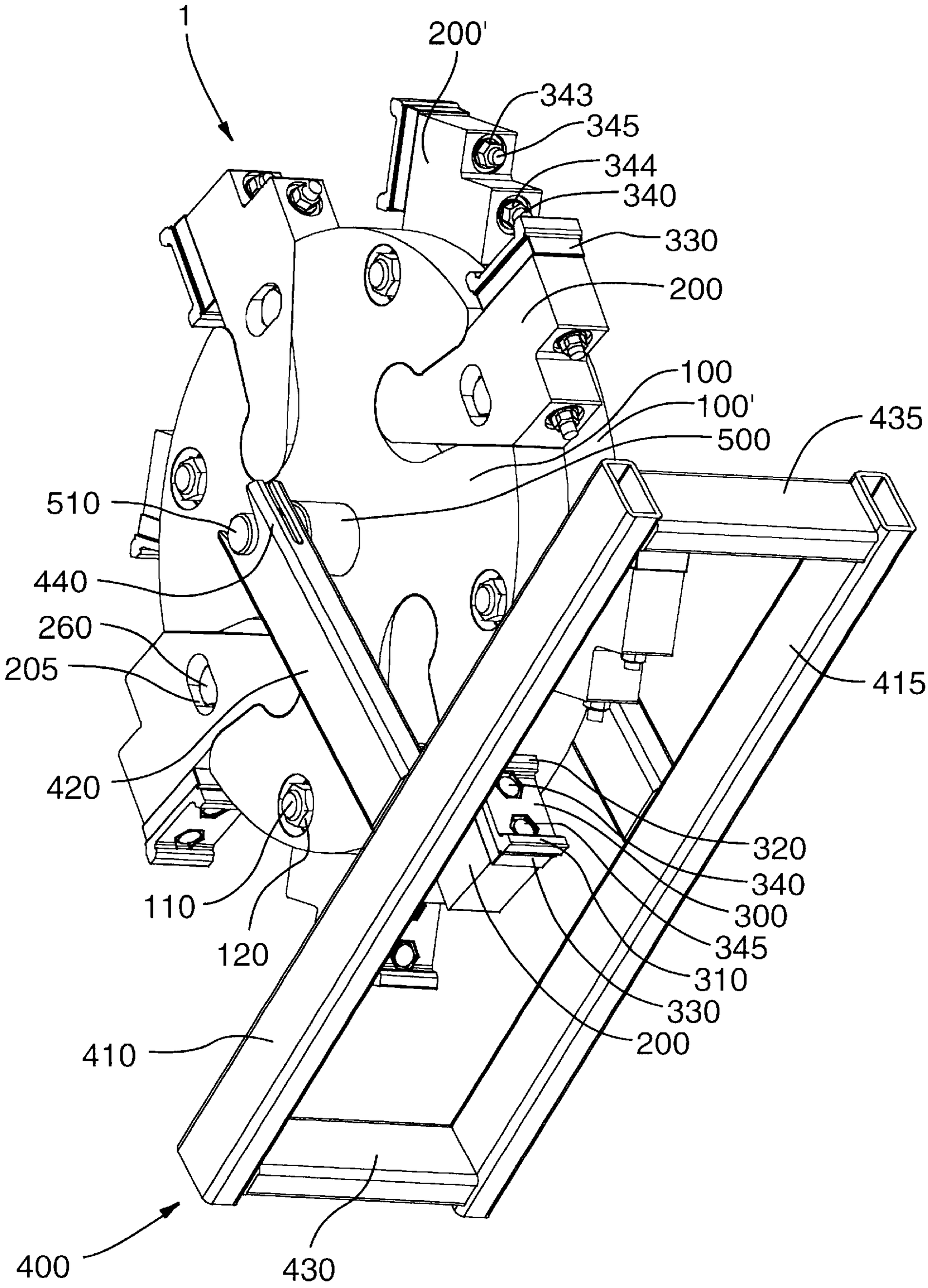

1
200'
343
345
344
340
330
200
100
100'
500
435
510
440
260
205
420
110
120
410
415
320
340
300
345
310
330
200
400
430

FIG.1B

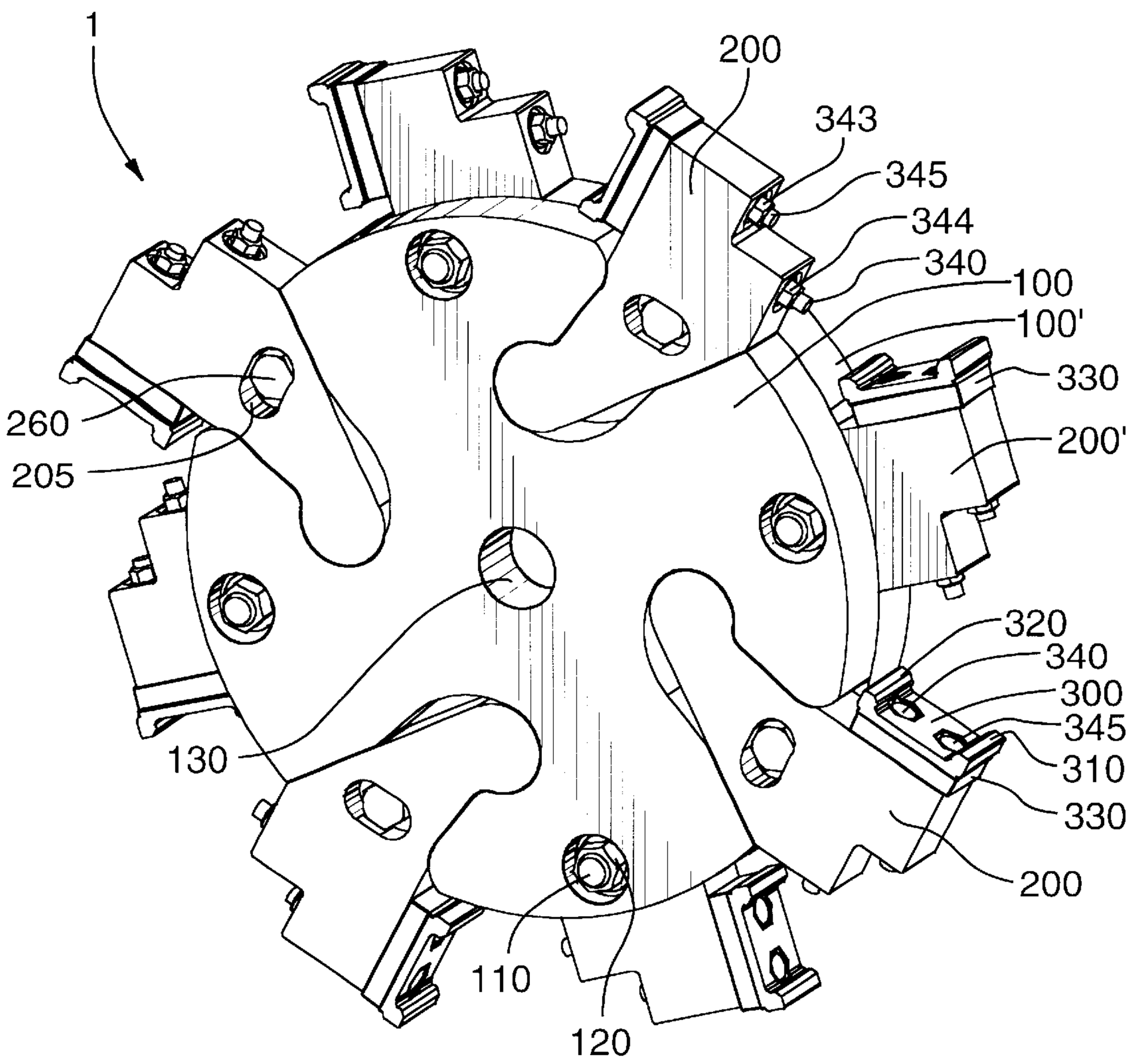

1
200
343
345
344
340
100
100'
330
200'
260
205
320
340
300
345
310
330
200
130
110
120

FIG.2

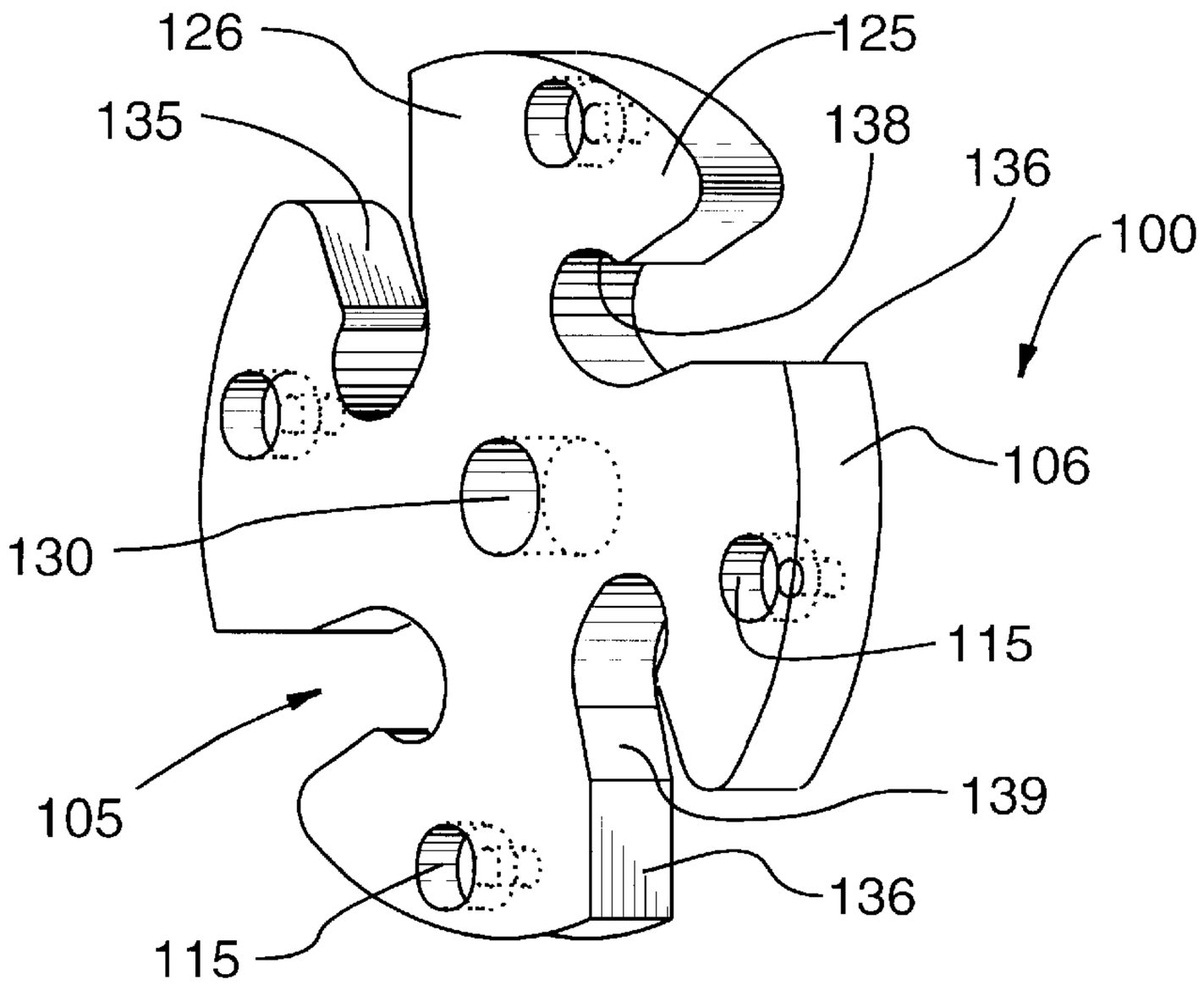

126
125
135
138
136
100
106
130
115
105
139
115
136

FIG.3A

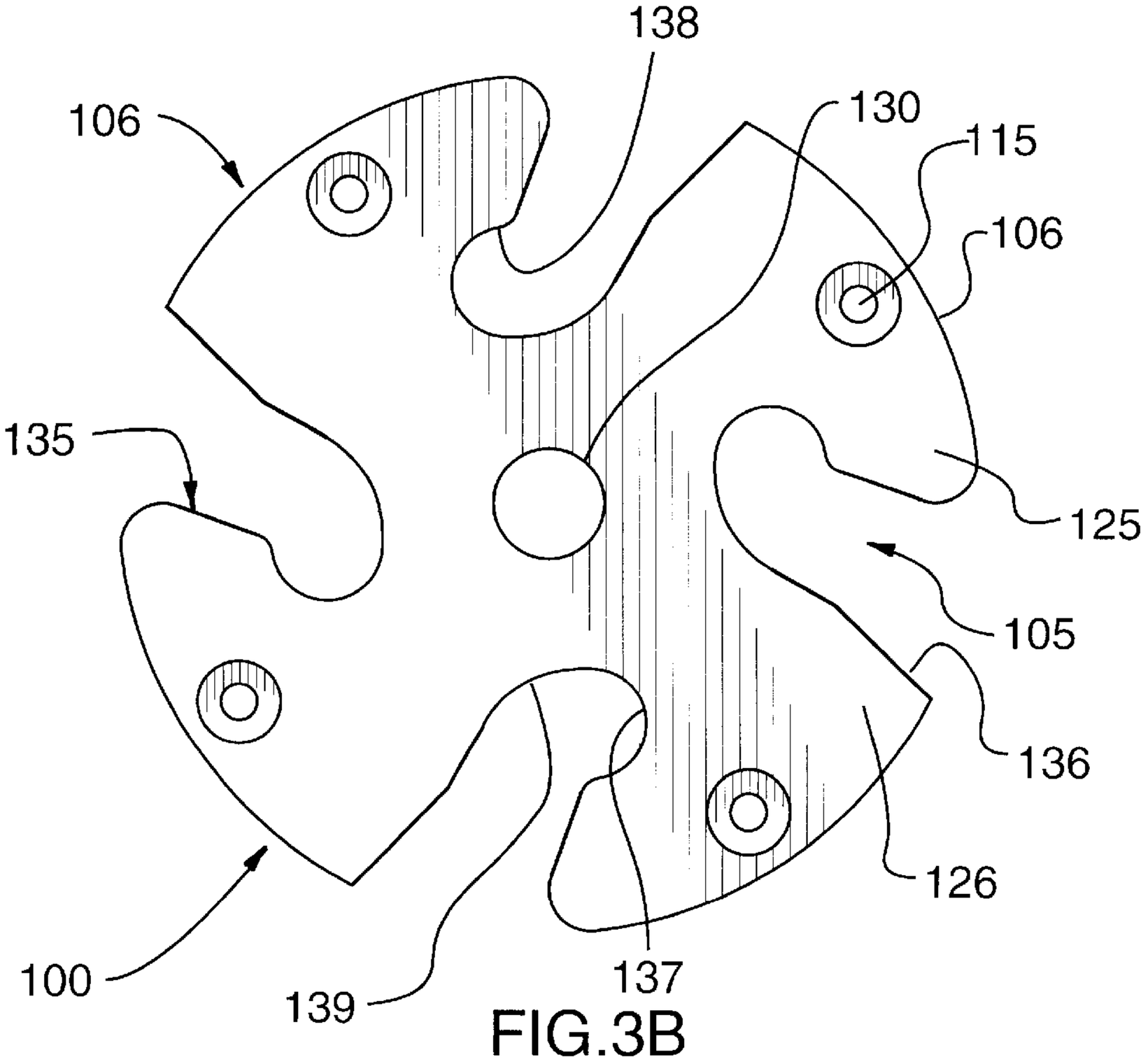

138
106
130
115
106
135
125
105
136
126
100
139
137

FIG.3B

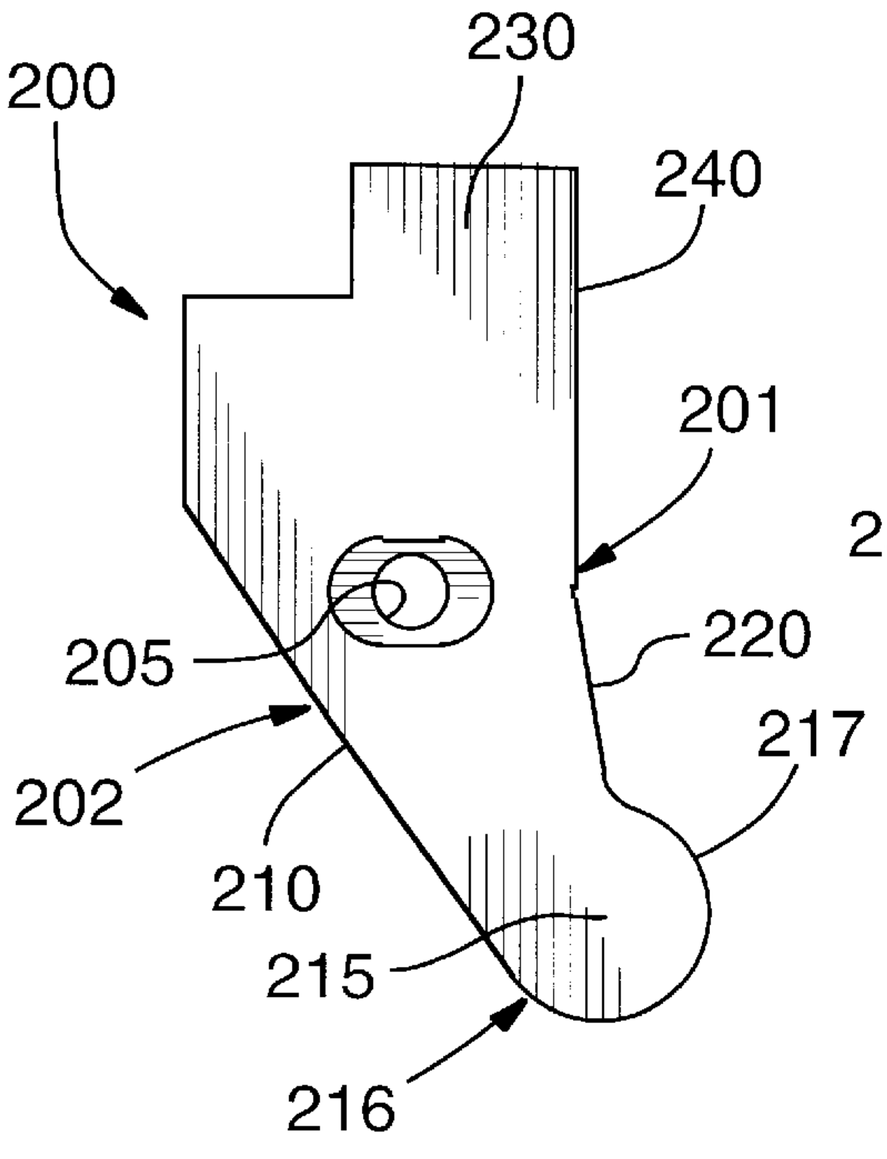


FIG.4B

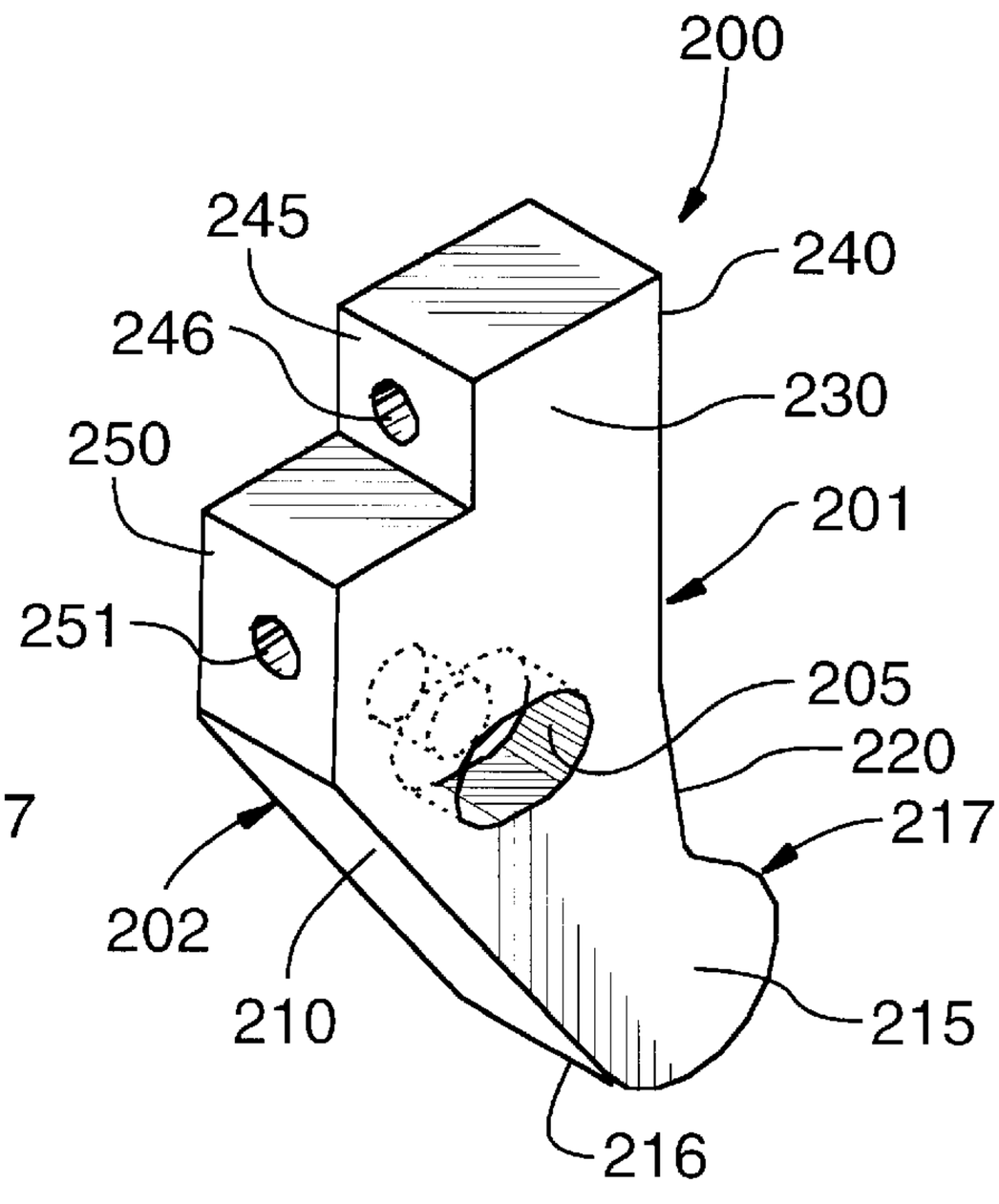


FIG.4A

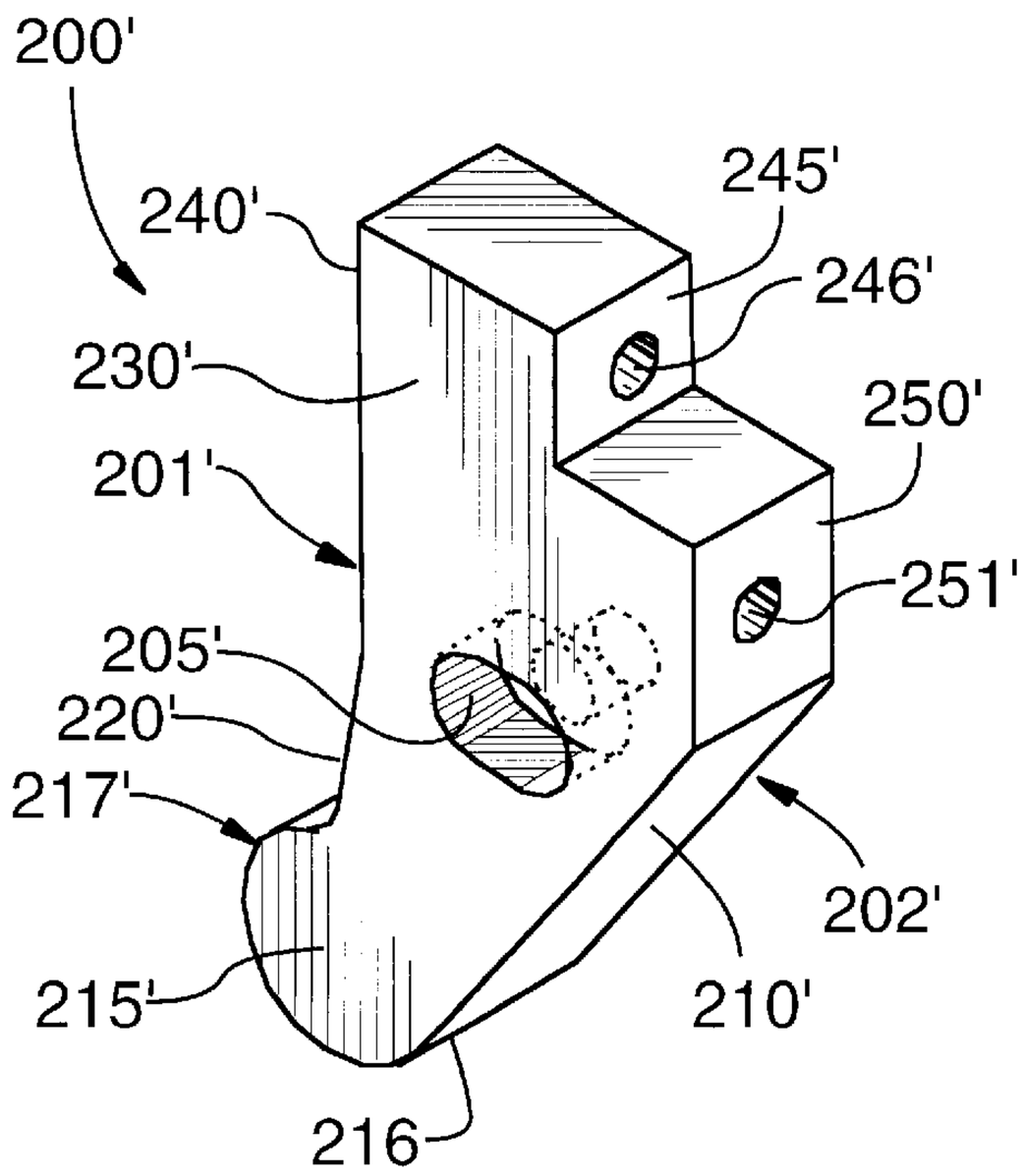


FIG.4C

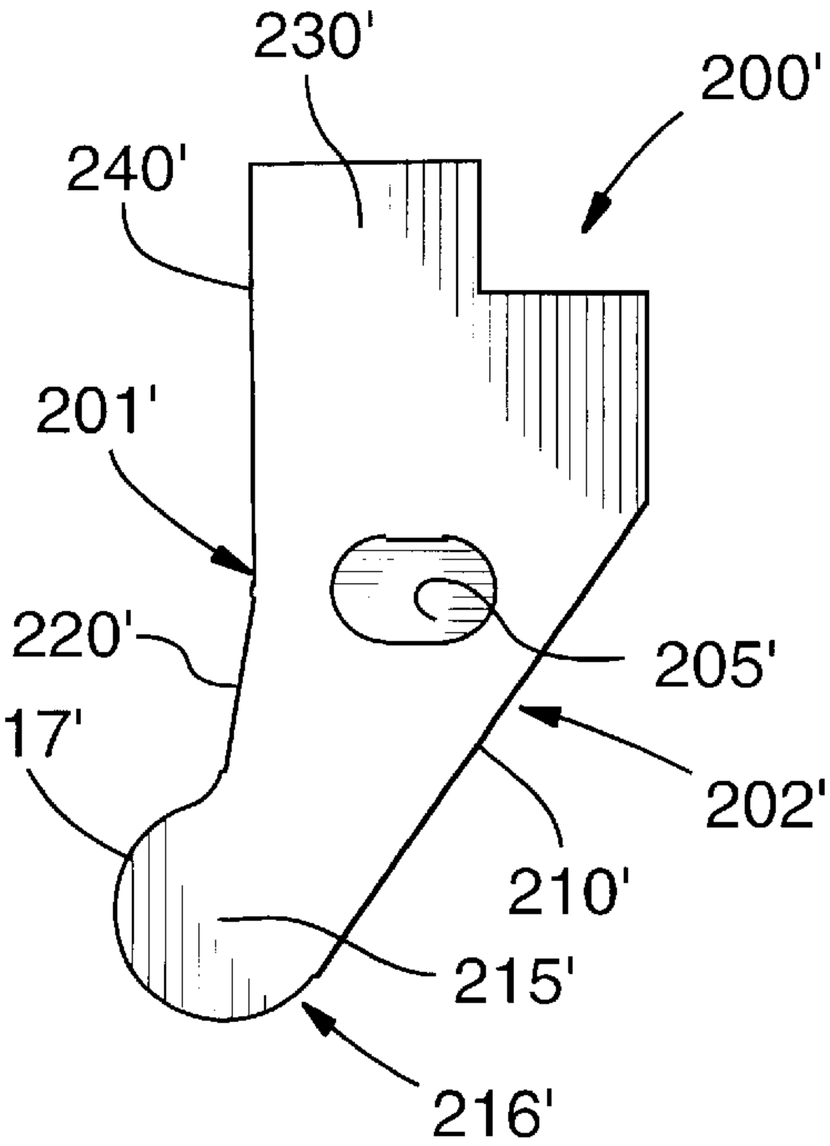


FIG.4D

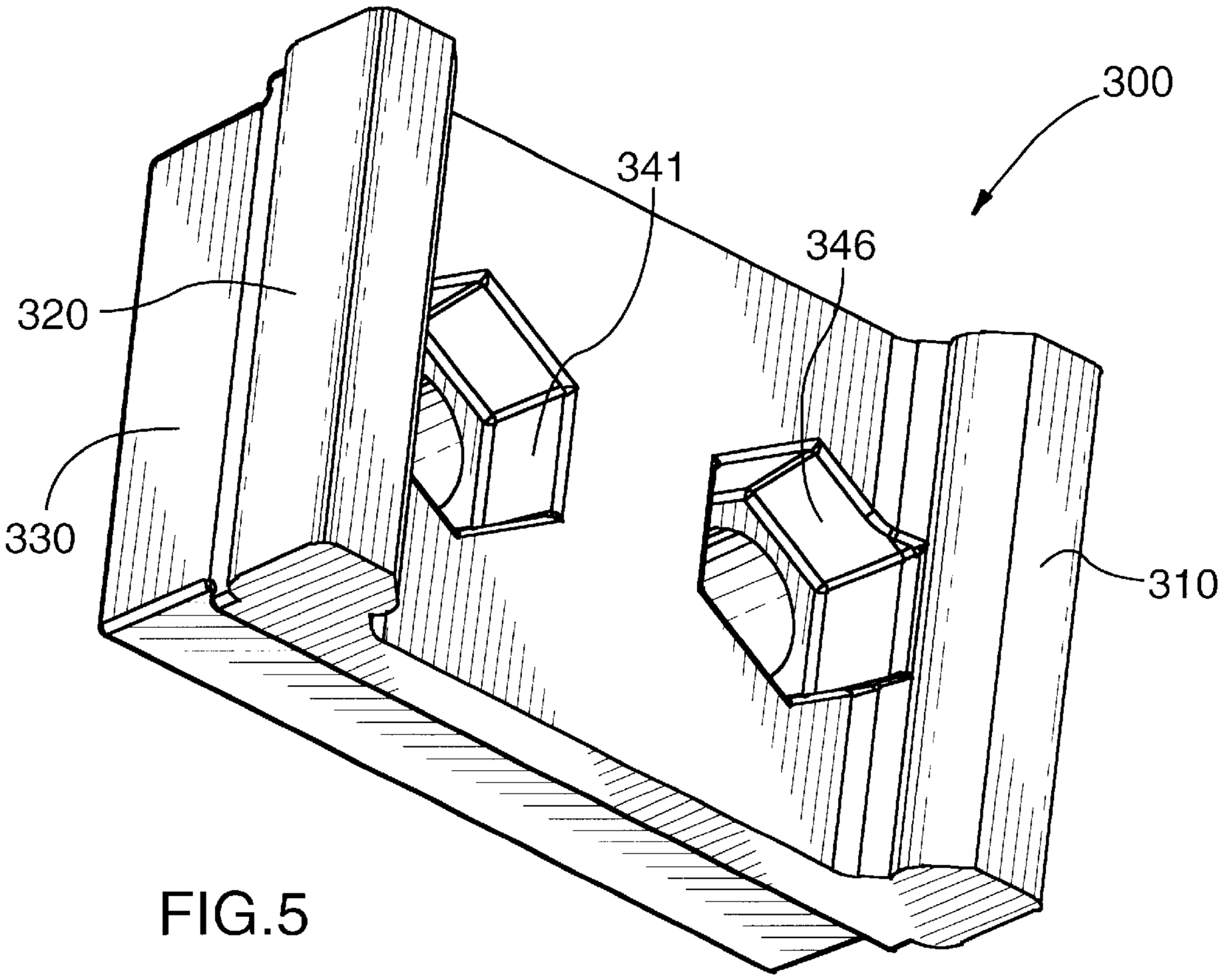


FIG.5

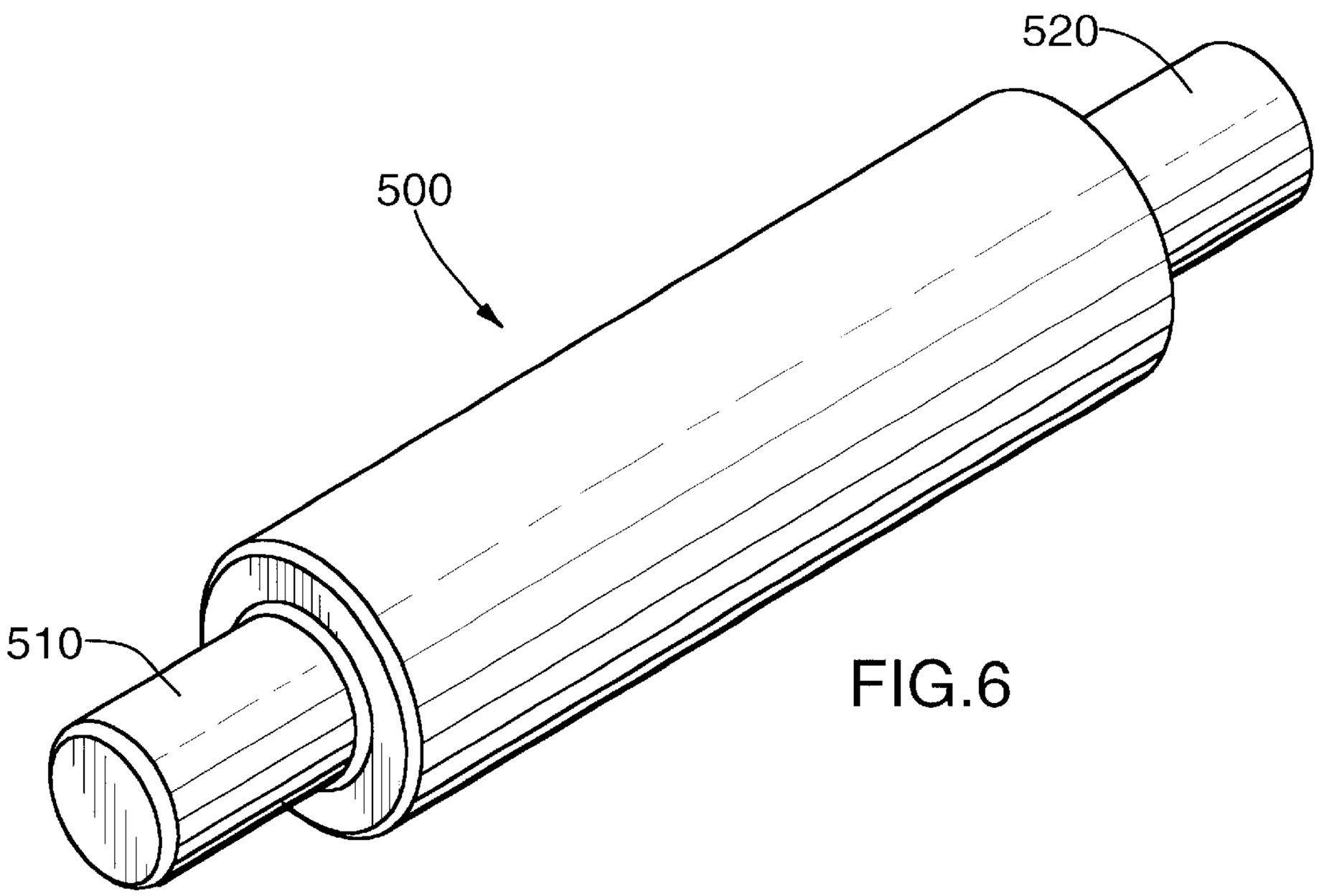


FIG.6

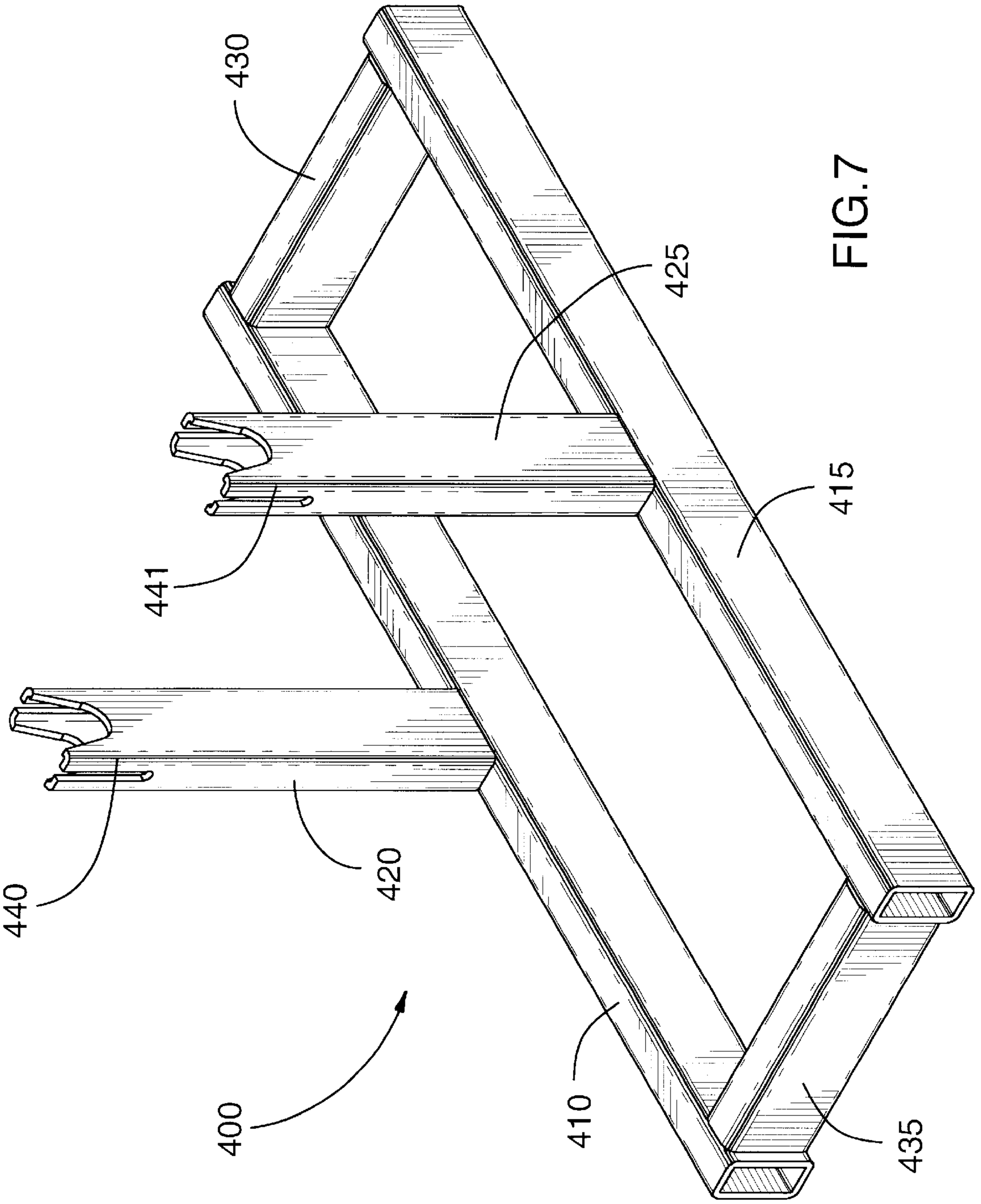


FIG.7

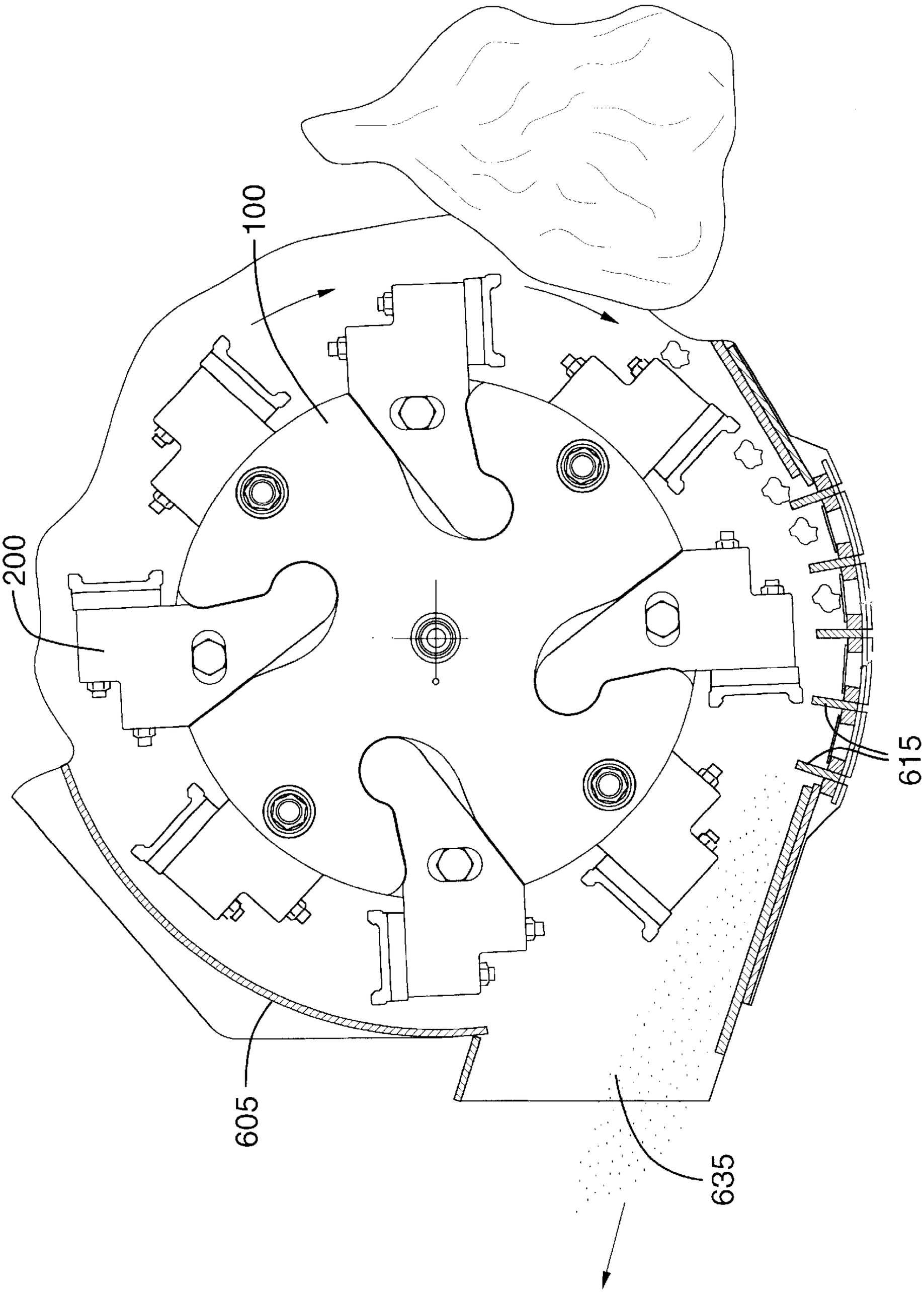


FIG.8A

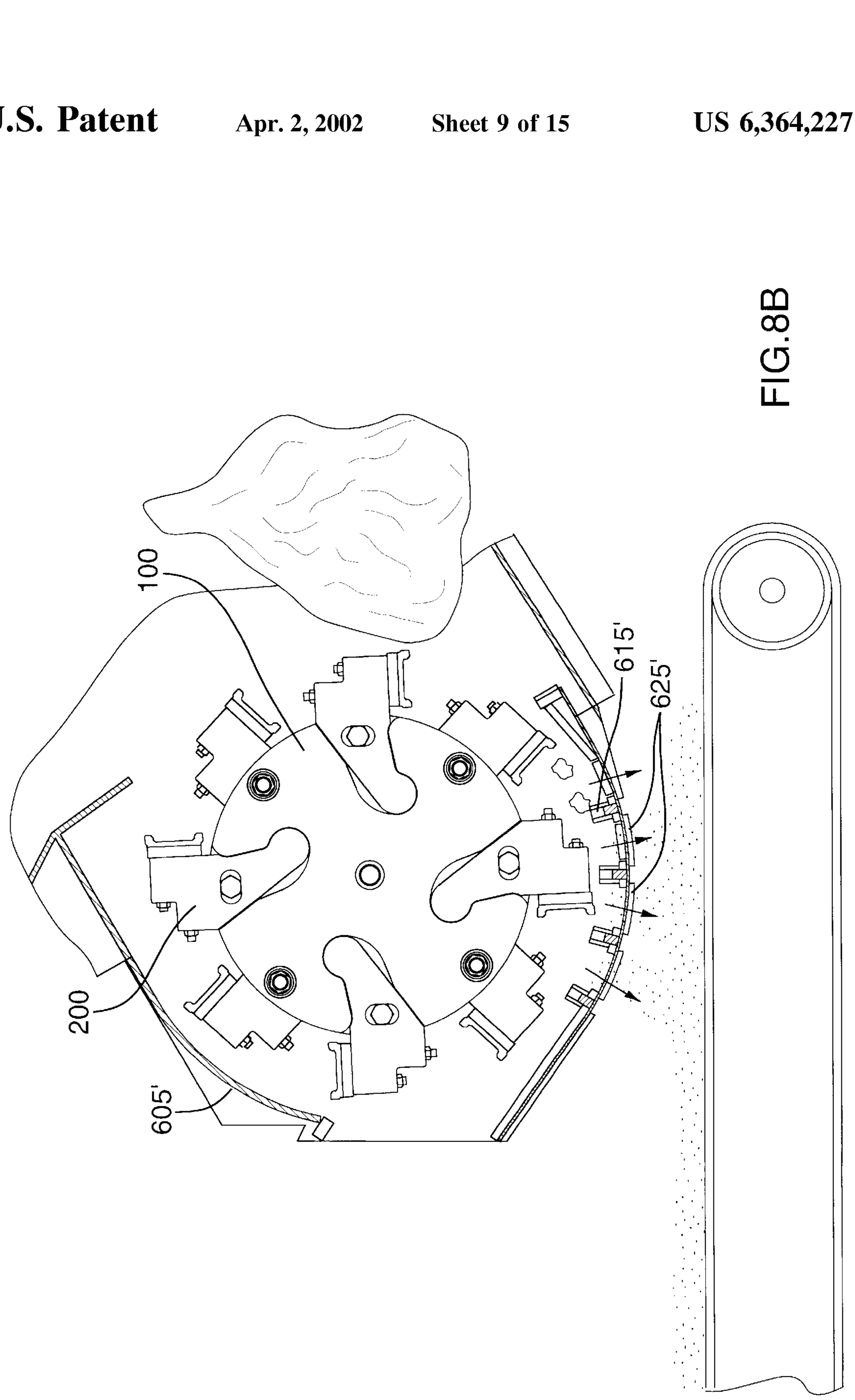


FIG.8B

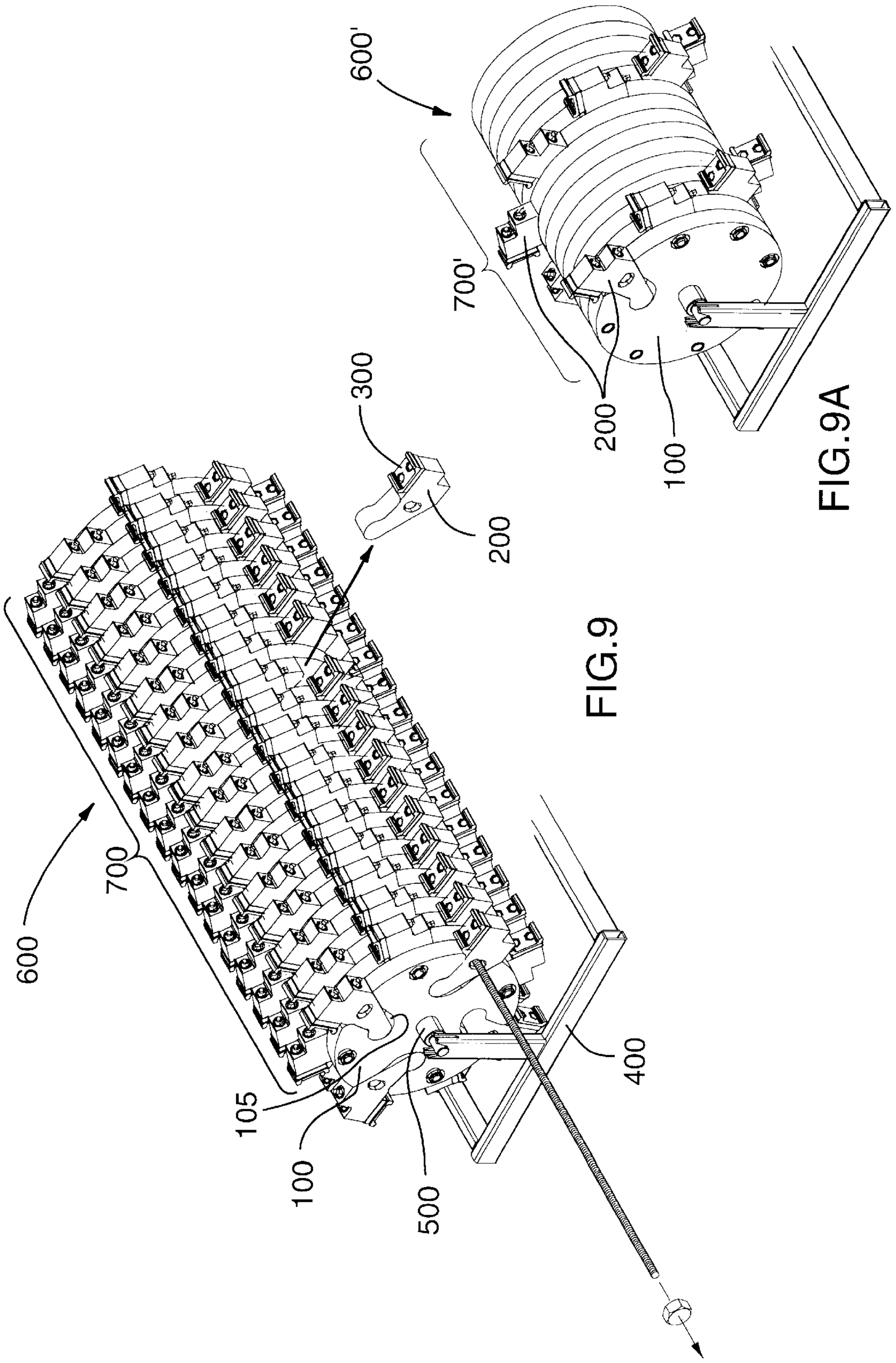


FIG.9A

FIG.9

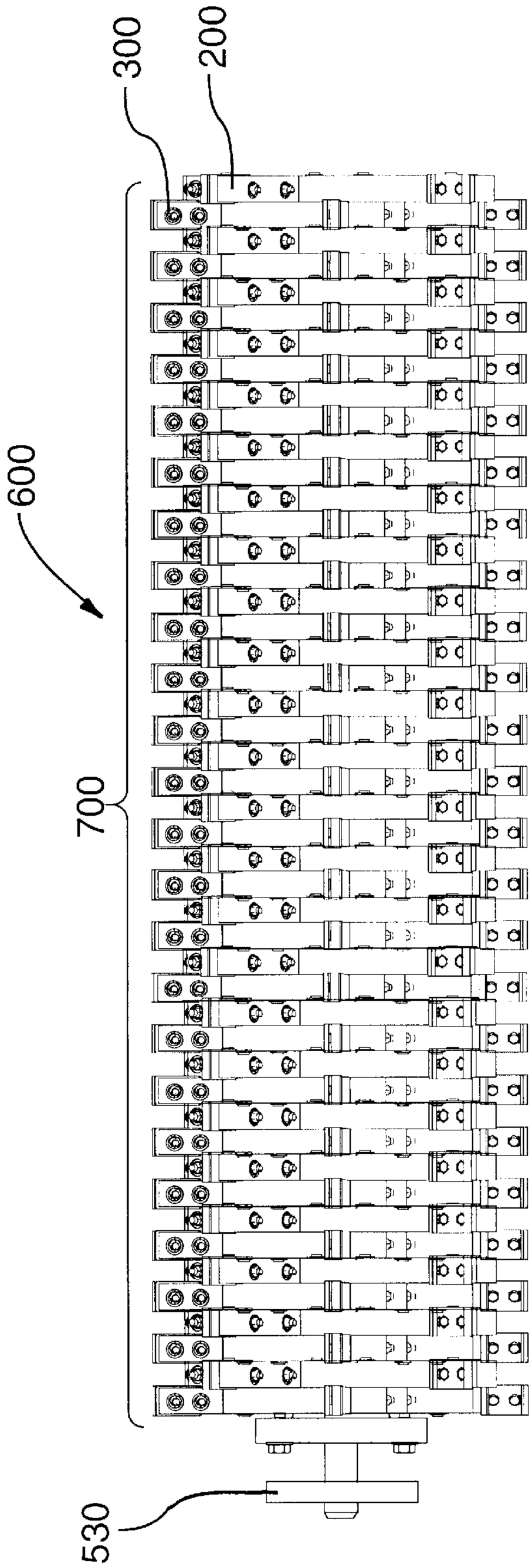

300
200
600
700
530

FIG.10

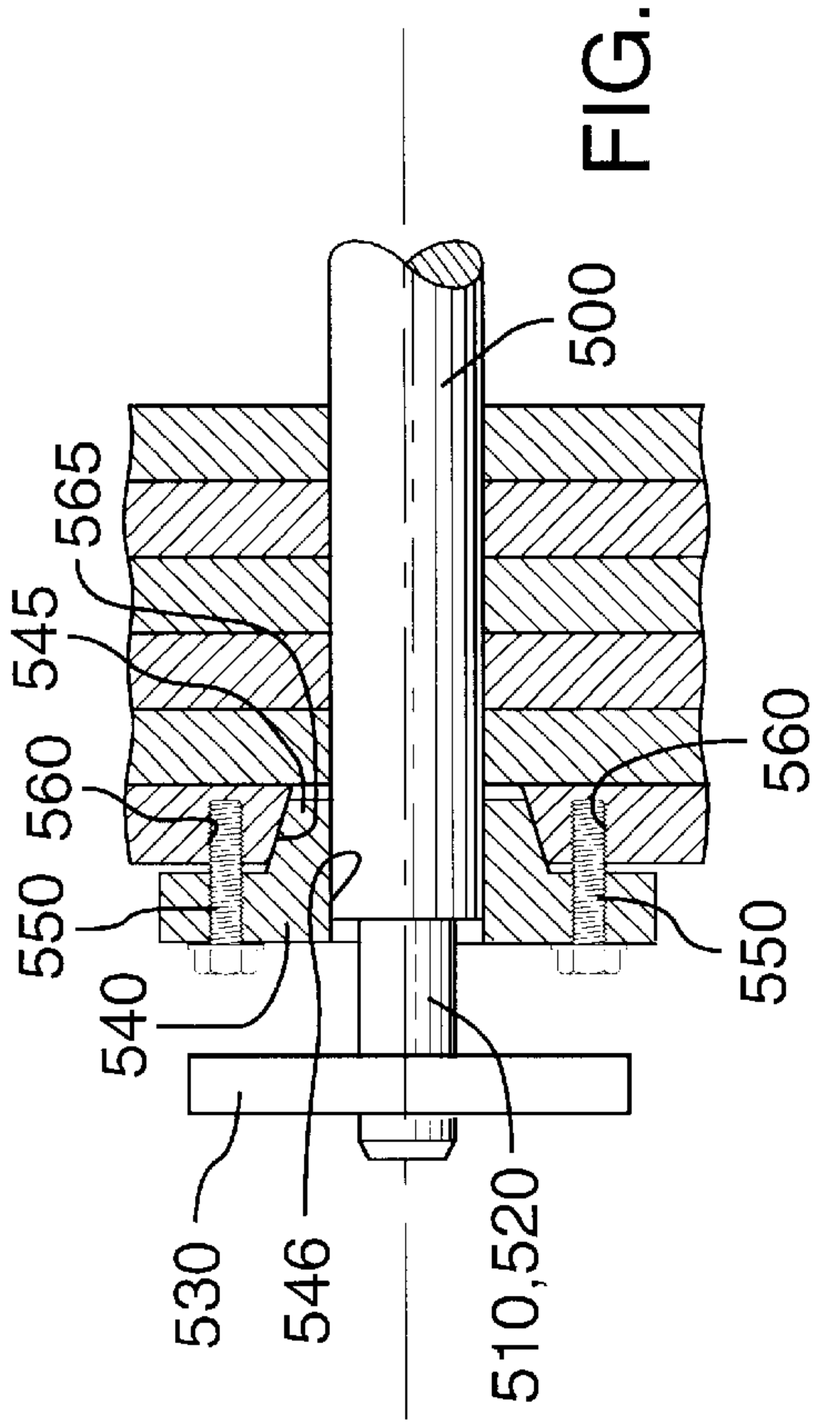

500
565
545
560
550
560
550
540
530
546
510,520

FIG.11

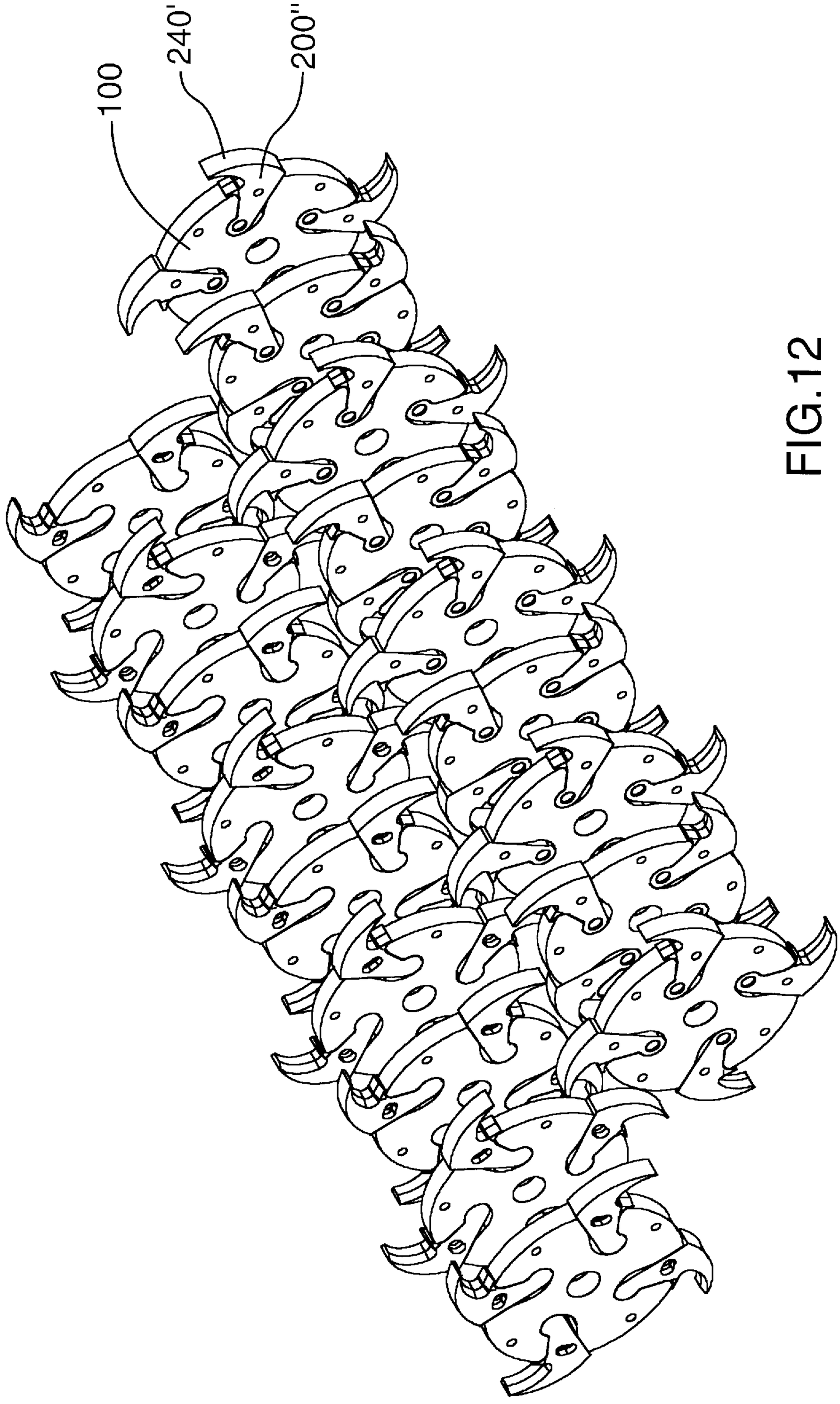


FIG.12

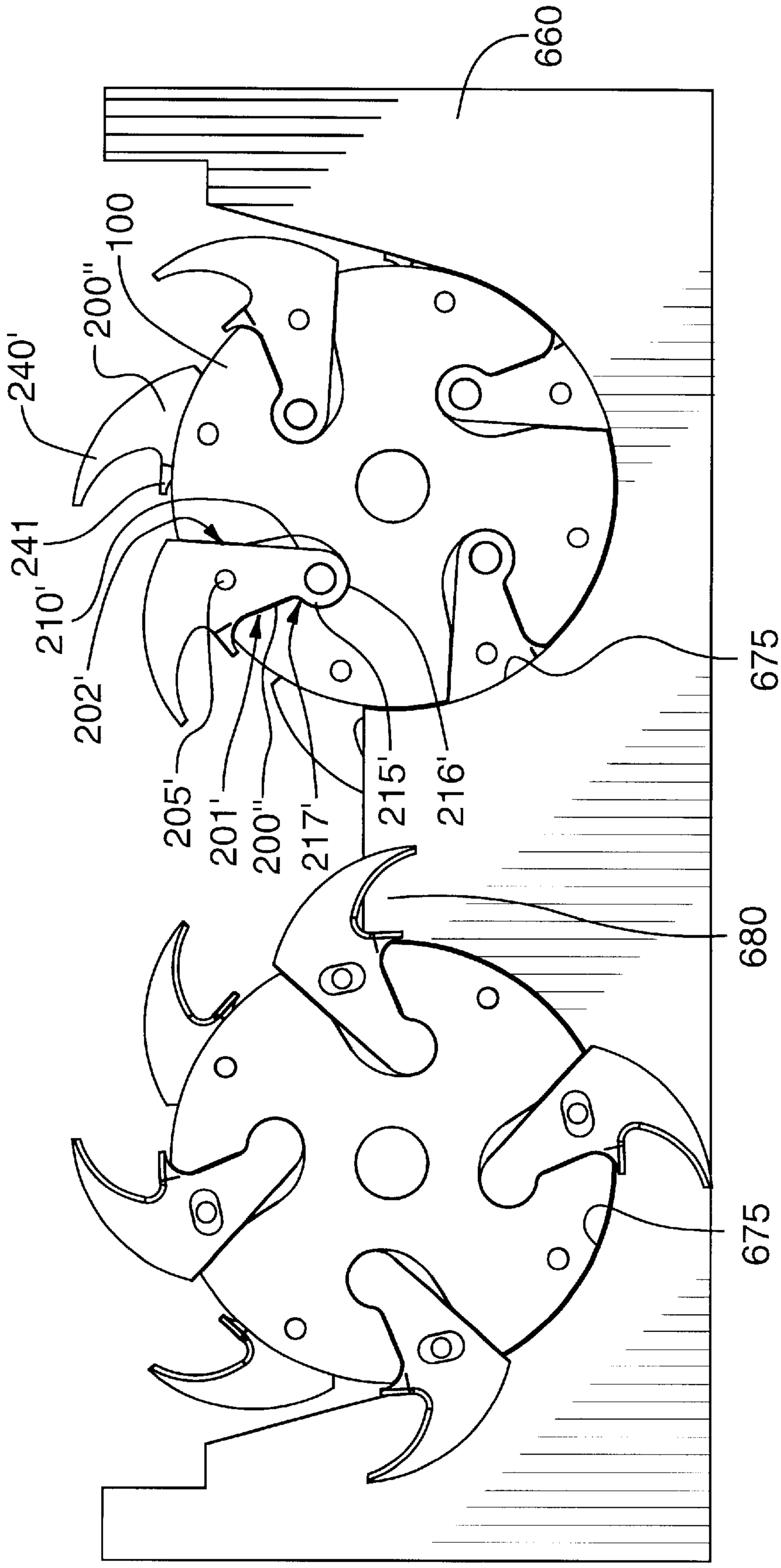


FIG. 13

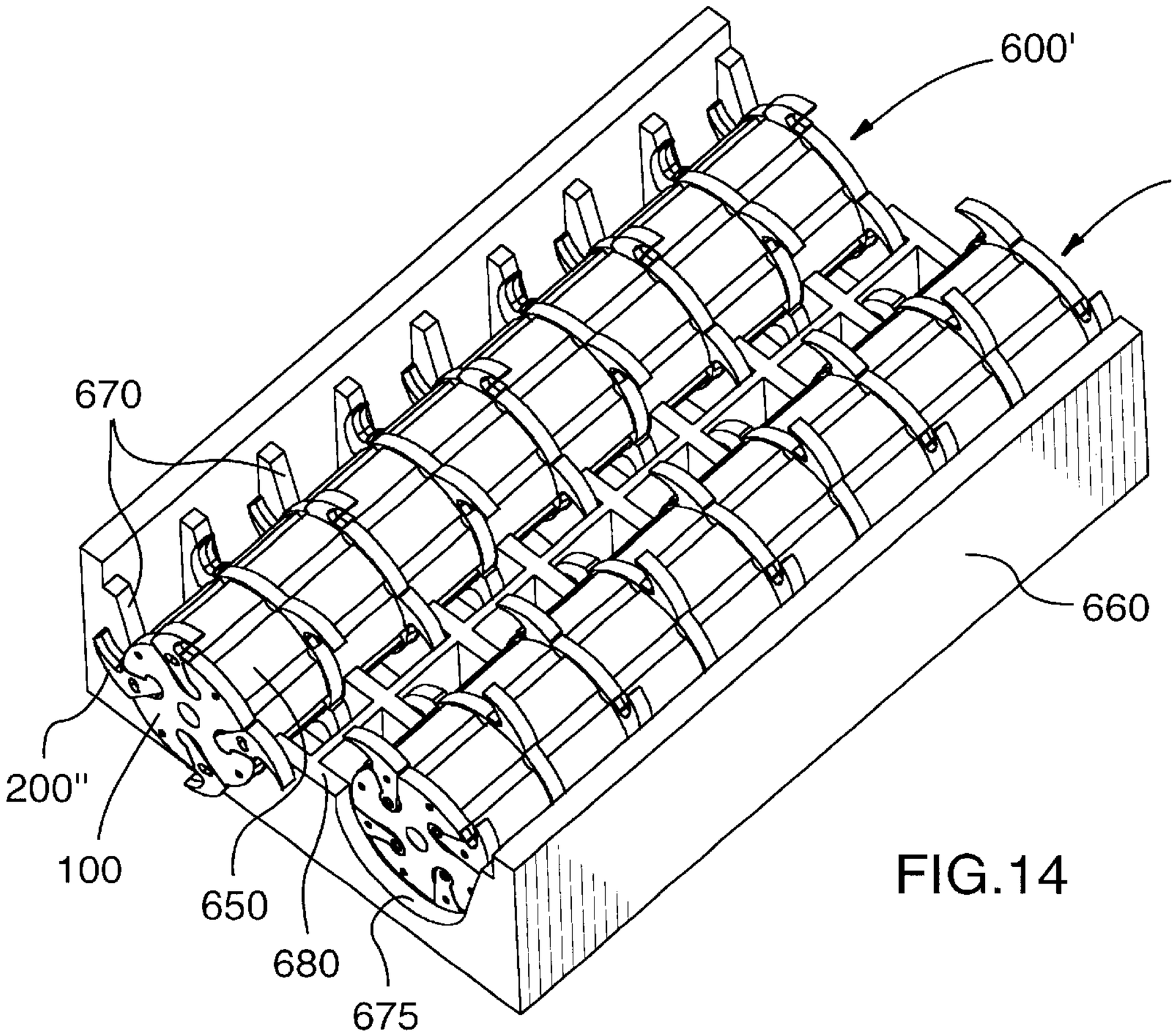

600'
600'
670
660
200"
100
650
680
675

FIG.14

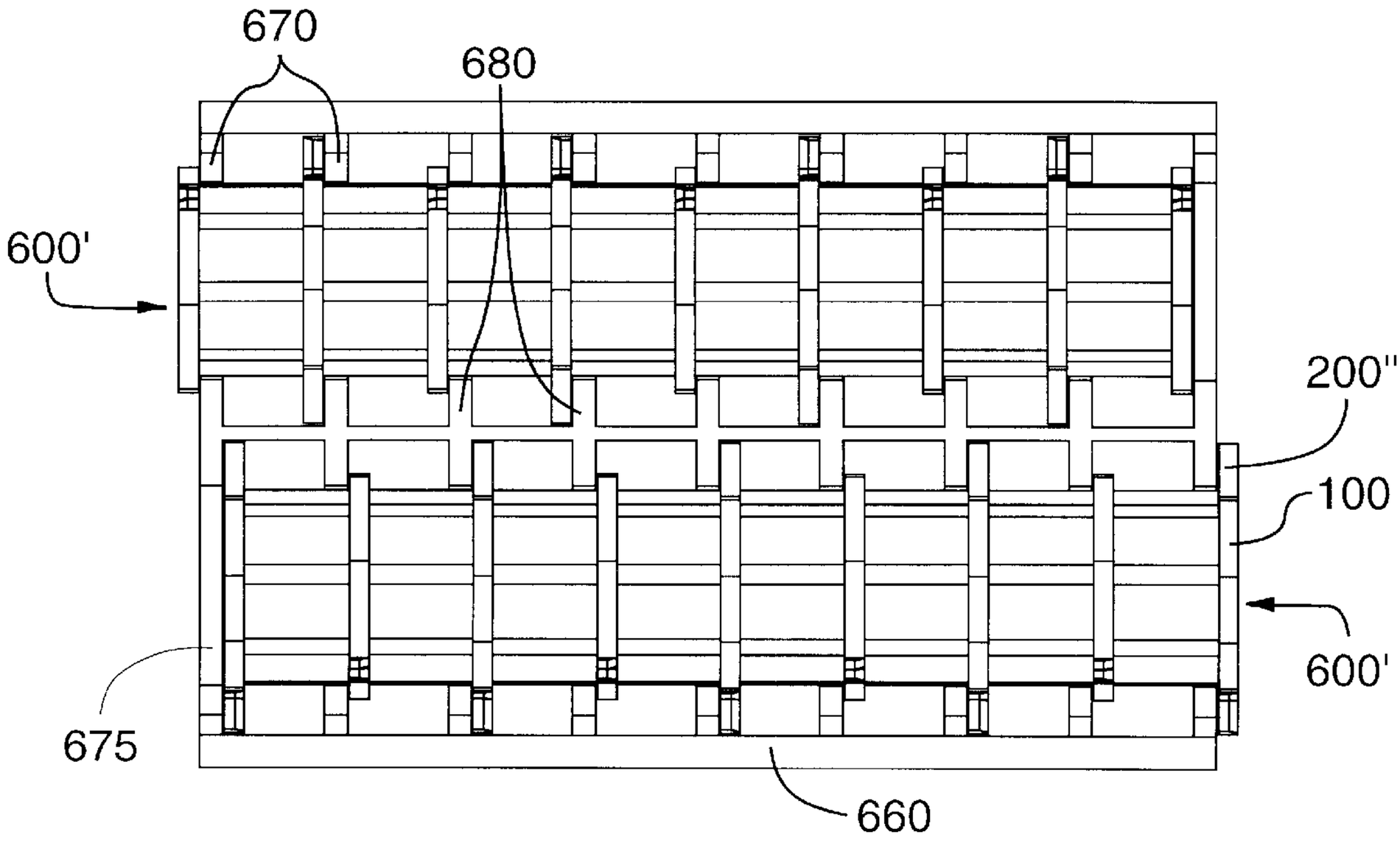

670
680
600'
200"
100
600'
675
660

FIG.15

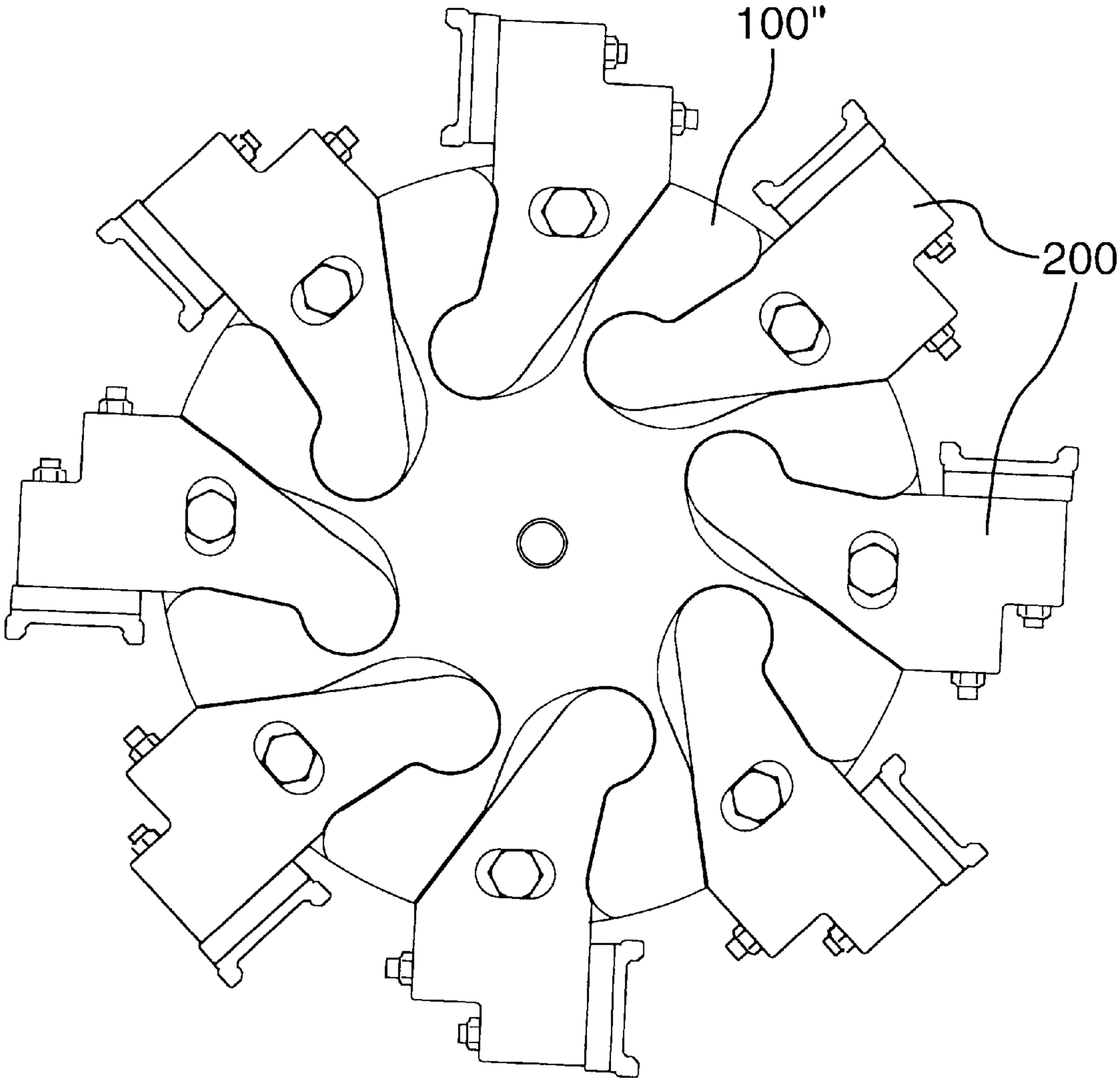


FIG.16

INTERFACE ELEMENTS FOR SHREDDER MILLS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a comminuting apparatus or shredder mill, and particularly to such an apparatus having grinding rotors with replaceable interface elements, such as hammers. Most particularly, the interface elements are interlockingly arranged in the rotors.

2. Description of the Prior Art

Traditionally, hammer mills having replaceable hammers use either one or more anchoring pins to directly secure the hammer to the rotor, see for example U.S. Pat. No. 5,484,111 (Dorscht et al.), U.S. Pat. No. 4,077,573 (Kersey et al.) or U.S. Pat. No. 5,114,985 (Inui), or use a system of clamping blocks and wedges to secure the hammer to a cutout in the rotors, see for example U.S. Pat. No. 5,320,292 (Smith).

The traditional hammer mills all share a number of apparent disadvantages and drawbacks. When the hammers get worn, it is complicated, and therefor expensive, to replace or repair this structure because either the anchoring pins or anchoring pin cover plates will have to be removed separately for each hammer to be replaced, which will pose accessibility problems when multiple rotor plates or bodies are used together, or retainers holding the clamping blocks will have to be removed to give access to the clamping blocks, with the associated problems regarding dis-assembly of the multi-piece clamp and wedge construction. Long hammer support rods are often damaged or worn, and are difficult to remove.

SUMMARY OF THE INVENTION

It is an object of the invention to mitigate and/or obviate the above mentioned disadvantages and drawbacks to provide a comminuting apparatus having interchangeable interface elements, which is easy and cheap to manufacture, assemble and service, and which provides the required shredding capacity.

One object of the invention is to provide an interchangeable interface element mounting system for the rotor, which allows the interchangeable interface elements to be easily removed, when wanted, but which provides large load carrying surfaces for the interface between interchangeable interface element and rotor body.

A further object of the invention is to provide multiple rotor bodies, which are easily joined to form rotating rolls having a plurality of axially and radially spaced interchangeable interface elements.

Still a further object of the invention is to provide a comminuting mill utilizing rotor bodies with easily replaceable interchangeable interface elements.

Yet a further object of the invention is to provide solid rotor bodies and interface elements, to increase the rotating mass factor and thus the potential energy of the system.

In the invention, an interchangeable and interlocking interface element and rotor assembly for rotary hammermills, comprises at least two rotor bodies, a plurality of interchangeable interface element mounting cut-outs arranged substantially radially in the at least two rotor bodies and a plurality of peripheral mounting holes arranged to receive rotor body bundling means to hold the at least two rotor bodies fixedly against each-other and to prevent the plurality of interchangeable interface elements to exit from the interchangeable interface element mounting cut-outs,

and a plurality of interchangeable interface elements arranged to be mountable in the interchangeable interface element mounting cut-outs. Each of the plurality of interchangeable interface elements have a substantially oblong and planar shape, a bottom end shaped to interlock with the interchangeable interface element mounting cut-outs, a leading edge facing the direction of rotation of the rotors, a trailing edge facing the side opposite to the direction of rotation, and interchangeable interface element tip mounting means, arranged in an upper mounting portion of each plurality of interchangeable interface elements. The interchangeable interface elements further have a bottom portion with a generally rounded surface arranged to cooperate with a generally rounded bottom portion of the interchangeable interface element mounting cutouts, a heel portion facing the direction of rotation and shaped to cooperate with a recess portion of the interchangeable interface element mounting cutouts so that during insertion of an individual interchangeable interface element in one interchangeable interface element mounting cut-out, by inserting the bottom portion first, the generally rounded surface is slidable into a relief recess portion of the interchangeable interface element mounting cut-outs, permitting the heel portion to clear the protruding portion and the interchangeable interface element to be seated with the bottom portion in the generally rounded bottom portion of the interchangeable interface element mounting cut-outs locking the individual interchangeable interface element from movement in a radial direction in the at least two rotor bodies, the plurality of interchangeable interface elements further having a first force absorbing surface, arranged on the trailing edge, and a second force absorbing surface, arranged on the leading edge, and interchangeable interface element securing fasteners, arranged to receive the rotor bundling means for securing the plurality of interchangeable interface elements axially to the at least two rotor bodies.

The rotors preferably have a substantially cylindrical outer edge, but alternatively could be square, hexagon shaped or similar.

The rotor bundling means preferably comprise rotor bolts and rotor nuts.

The at least two rotor bodies are preferably fixably arranged on a rotatable common shaft running through central mounting holes in the at least two rotor bodies.

The at least two rotor bodies are preferably attached to the rotatable shaft using a pair of conical bushings arranged to clamp the rotatable shaft to the at least two rotor bodies.

The plurality of interchangeable interface elements preferably have replaceable interchangeable interface element tips arranged at an outer end of the plurality of interchangeable interface elements facing the leading edge.

The assembly may comprise interchangeable interface elements arranged in straight rows or interchangeable interface elements arranged along helical curves.

The rotatable shaft is preferably rotated by a hydraulic motor, an electric motor or an internal combustion engine.

Thus, no load carrying pins are used, the interchangeable interface element holder is instead shaped to be slidable into a cutout in the rotor and held in the cutout by a heel formed at a lower part of the interchangeable interface element holder. The heel is held by a corresponding protruding portion of the cutout.

Further features of the invention will be described or will become apparent in the course of the following detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

In order that the invention may be more clearly understood, the preferred embodiment thereof will now be

described in detail by way of example, with reference to the accompanying drawings, in which:

FIG. **1A** is a schematic elevational perspective side view of an assembled rotor according to the invention, the rotor shown on a holding/transport stand,

FIG. **1B** is a schematic bottom perspective side view of the rotor of FIG. **1A**,

FIG. **2** is a schematic elevational perspective side view of the assembled rotor according to the invention, showing the rotor and interchangeable interface element assembly,

FIG. **3A** is a elevational perspective side view of a rotor body according to the invention,

FIG. **3B** is a side view of the rotor body according to FIG. **3A**,

FIG. **4A** is an elevational perspective side view of an interchangeable interface element according to the invention, showing the interchangeable interface element from the side facing backwards compared to the direction of rotation and without a mounted interchangeable interface element tip,

FIG. **4B** is a side view of the interchangeable interface element of FIG. **4A**,

FIG. **4C** is an elevational perspective side view of a further interchangeable interface element according to the invention, showing the further interchangeable interface element from the side facing backwards compared to the direction of rotation and without a mounted interchangeable interface element tip,

FIG. **4D** is a side view of the further interchangeable interface element of FIG. **4C**,

FIG. **5** is an elevational perspective side view of a interchangeable interface element tip according to the invention,

FIG. **6** is an elevational perspective side view of a transport shaft according to the invention,

FIG. **7** is an elevational perspective side view of the holding/transport/service stand according to FIG. **1A**,

FIG. **8A** is a side view of a comminuting mill having a plurality of rotor assemblies according to the invention, showing the use of bars for comminuting and holding the material to be shredded for impact with the interchangeable interface elements,

FIG. **8B** is a side view of a comminuting mill having a plurality of rotor assemblies according to the invention, showing the use of a grid for screening and holding the material to be shredded for impact with the interchangeable interface element,

FIG. **9** is an elevational side view of a plurality of rotor assemblies according to the invention, showing one rotor bolt and one interchangeable interface element removed,

FIG. **9A** is an elevational side view of a plurality of rotor assemblies according to the invention, showing how the interchangeable interface elements of one embodiment are arranged in a helical pattern,

FIG. **10** is a side view of a plurality of rotor assemblies according to the invention,

FIG. **11** is a partially sectioned side view of a rotor drive according to one embodiment of the invention,

FIG. **12** is an elevational side view of a plurality of rotor assemblies according to a further embodiment of the invention, showing interchangeable interface elements in the shape of knives,

FIG. **13** is a side view of a shredding apparatus according to an embodiment of the invention, having rotor assemblies arranged in a housing, the rotors using the interface elements as shown in FIG. **12**,

FIG. **14** is an elevational side view of the shredding apparatus of FIG. **13**,

FIG. **15** is a top view of the shredding apparatus of FIG. **13**, and

FIG. **16** is a side view of a rotor body having eight interchangeable interface elements.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIGS. **1A**, **1B** and **2**, a rotor assembly **1** having a plurality of rotors bodies **100**, **100'** with a plurality of interchangeable interface elements, shown as hammers **200**, **200'**, mounted on the rotors is shown. Advantageously, the rotor assembly has a common shaft **500**, which has end mounting pins **510** and **520** (see FIG. **6**), which are held in shaft holders **440** and **441** (see FIG. **7**) of a stand **400**, for transporting, servicing and/or storing the rotor assembly. The stand may have wheels (not shown) for easy transportation of the rotor assemblies. The rotors are fastened or bundled to each other using fasteners or bundling means, for example rotor bolts **110** and rotor nuts **120** as shown. Each hammer **200**, **200'** has a hammer tip **300** mounted on one side of the hammer using tip fasteners, preferably upper hammer tip bolts **345**, lower hammer tip bolts **340**, upper hammer tip nuts **343** and lower hammer tip nuts **344** as shown.

Each rotor has a rotor body **100**, as shown in detail in FIGS. **3A** and **3B**, having a substantially circular circumference **106**. A plurality of cutouts **105** are arranged radially in the body for receiving hammers (not shown). A central hole **130** is arranged in the body **100** to receive the common shaft of the rotor assemblies. Further, hammer mounting holes **115** are arranged to axially hold hammers of an adjacent rotor body, when the rotor body is fastened to at least one further rotor body **100'** (see FIG. **2**). Thus, the minimum number of rotor bodies used to form one rotor assembly **1** is two. The maximum number of rotor bodies used is dictated by available space and the actual application in which the rotor assembly is being used. Each cutout **105** has a first side **135**, facing the direction of rotation of the rotor when in use, a second side **136**, facing the opposite direction to the direction of rotation, and a generally rounded bottom portion **137**, which ends in a protruding portion **138** for retaining the hammer in the cutout during rotation of the rotor (as described in more detail below). The shape of the cutout generally conforms to the outer shape of a hammer **200**, **200'**, which will be described in more detail later, except for a portion of the second side **136**, which has a relief recess portion **139**, which allows the insertion of the hammer into the cutout.

As is shown in FIGS. **4A** and **4B**, a first embodiment of a hammer **200** has a third side **201**, facing the direction of rotation of the rotor when the hammer is installed in a rotor and the rotor is in use, a fourth side **202**, facing the opposite direction to the direction of rotation, and a bottom portion **215** having a generally rounded surface **216**, which is arranged to cooperate with the generally rounded bottom portion **137** of the cutout **105**. The bottom portion of the hammer has a force absorbing heel portion **217** facing the direction of rotation as specified earlier, the heel portion being shaped to cooperate with the recess portion **138** of the cutout to lock the hammer movement in a radial direction in the rotor body **100**. The first embodiment of hammers **200** further has a first force absorbing surface **210**, arranged on

the fourth side **202** of the hammer, and a second force absorbing surface **220**, arranged on the third side **201** of the hammer. The hammer is preferably generally wedge-shaped, with a wide portion **230** outwards from the rotor body and the narrow portion inwards and terminating in the bottom portion **215**. At the wide portion of the hammer, adjacent the impact end **240** of the hammer, hammer tip **300** upper mounting means **246** are arranged in an upper mounting portion **245** of the hammer, facing the intended impact direction of the hammer. Preferably, arranged in a lower mounting portion of the hammer at the wide portion of the hammer are hammer tip **300** lower mounting means **251**. The upper and lower mounting means are, for example but not exclusively, bolt holes, mounting profiles, threaded holes, other holes etc. As described in conjunction with FIG. **1**A, the preferred fastening means for the hammer tips are bolts and nuts, but any suitable fastener may be used, such as rivets, mounting rails with locking screws, bolts threaded into threaded holes, welding or brazing the tip directly to the hammer, etc. The first embodiment of hammers **200** further has a hammer securing fastener **205**, preferably a hole with a recess for a bolt head (as shown). The rotor bolts **110** are arranged to be inserted in the hammer securing fastener for securing the hammer to the rotor body assembly, as will be described later.

Depending upon which rotor body the hammer is to be mounted on, there are two embodiments of hammers: a first embodiment **200** described above, and a second embodiment of hammers **200'**. The second embodiment of hammers are shown in FIGS. **4**C to **4**D, and are identical to the first embodiment of hammers **200**, except for the hammer securing fastener **205'** which is arranged to be accessed from the opposite side of the hammer, compared to the first embodiment of hammers. In this way, the hammers of the outermost rotor bodies of a rotor are chosen so that the hammer securing fastener **205**,**205'**, respectively, permit the easy manipulation of the rotor bolts **110** and rotor nuts **120**. In FIGS. **4**C to **4**D, the reference numerals used are the same as for FIGS. **4**A to **4**B for similar technical features, except that a "prime" designation has been added. For example, the force absorbing heel portion of a first embodiment hammer **200** has the designation **217**, whilst the force absorbing heel portion of a second embodiment hammer **200'** has the designation **217'**.

In FIG. **5**, one embodiment of a hammer tip **300** is shown. The actual shape of the hammer tip is not critical to the invention, but is dictated by the desired shredding performed (type of material to be shredded, capacity, cost etc.). The hammer tip **300** according to the preferred embodiment is substantially rectangular in shape, having a first ridge **310**, facing the direction of rotation of the rotor when the hammer tip is fastened onto a hammer, which, in turn, is inserted into a cutout of a rotor body. Further, a second ridge **320** is arranged at an end of the hammer tip opposite to the end having the first ridge **310**. The first and second ridge are the areas of the hammer tip which first contact the material to be shredded, when the shredder is in use. Further, a flat backing plate portion **330** of the hammer is arranged behind the hammer tip **300**. The hammer tip **300** further preferably has a first mounting hole **341** and a second mounting hole **346**, for attaching the hammer tip to the upper mounting means of the hammer and the lower mounting means **251** of the hammer, respectively, in the preferred embodiment. The hammer tip mounting method of course depends on the arrangement of the tip mounting means on the hammer, and vice-versa.

FIG. **6** shows the common shaft **500**, used as a drive shaft/storage shaft, for mounting at least two rotor bodies, with or without attached hammers. The shaft has a first end **510** and a second end **520**, preferably shaped as mounting pins for cooperation with a first shaft mount **440** and a second shaft mount **441** of the stand **400**, used to store or transport a rotor assembly (rotor bodies with or without hammers mounted on a common shaft). The stand preferably has a substantially rectangular frame having a first side **410**, a second side **415**, a first end **430** and a second end **435**. The first shaft mount **440** is arranged at a top of a first leg **420**, arranged vertically on the first side **410**, and the second shaft mount **441** is arranged at a top of a second leg **425**, arranged vertically on the second side **415**.

When inserting a hammer **200** in a cutout **105**, the bottom portion **215** of the hammer is inserted first, and the generally rounded surface **216** of the hammer is slid into the relief recess portion **139** of the cutout. This action permits the heel portion **217** of the hammer to clear the protruding portion **138** of the cutout and the hammer to be seated with the bottom portion in the generally rounded bottom portion **137** of the cutout. The rotor bodies **100**, **100'** (see FIG. **1**A), respectively, are then secured to each other by inserting the rotor bolts **110** into the hammer securing fastener **205** of one rotor and into the hammer mounting holes **115** of an adjacent rotor. Rotor nuts **120** are thereafter tightened onto the rotor bolt end opposite the head of the rotor bolt, to securely hold the hammers in position in their respective cutouts. During use, virtually no force is transmitted from the impact of the hammer heads on the material to be shredded to the rotor bolts **110**, substantially all the force is absorbed by the interfaces between the aforementioned third and fourth sides **201**, **202**, respectively, of the hammers **200**, and the cutouts **105** of the rotor bodies **100**, **100'**. Thus, the rotor bolts are not easily deformed, broken or worn during operation of the rotor for shredding material.

After insertion, the hammer **200** is prevented from being flung out of the cutout **105** by the heel portion **217** of the hammer being held by the protruding portion **138** of the cutout, as previously described. When a hammer **200** is worn, necessitating replacement, the rotor bolt **110** holding the hammer in question is loosened, whereby the hammer can be slid out of the cutout **105**, by sliding the generally rounded surface **216** of the hammer via the relief recess portion **139** of the cutout. This action permits the heel portion **217** of the hammer to clear the protruding portion **138** of the cutout and the hammer can be removed from the cutout, without having to disassemble the rotor assembly further, saving both time and money for the shredding operator.

FIG. **8**A shows an embodiment of a comminuting mill according to the invention, where the rotor assembly is arranged inside a housing **605**. The housing has an inlet for material to be comminuted and bars **615** for breaking up the material further. All pieces go out through an outlet **635**.

FIG. **8**B shows a further embodiment of a comminuting mill according to the invention, where the rotor assembly is arranged inside a housing **605'**. The housing has an inlet for material to be comminuted and a screening means comprising frames **615'** and screened openings **625'** arranged between the frames. The pieces go out through the screened openings **625'** and onto a conveyor **665**.

In FIGS. **9**, **9**A and **10**, an assembled rotor **600** is shown comprising a plurality of rotor bodies **100** arranged on a common shaft **500**. Each rotor body is rotated a certain angle, with respect to its neighbouring rotor body, to allow hammers **200** inserted in the cutouts **105** to protrude from the rotor **600** at alternating positions axially along the rotor.

In this way, the access to each individual hammer is enhanced, at the same time as the efficiency of the rotor for shredding purposes is maintained. Thus, rows of hammers **700** are formed, individual hammers being held by every other rotor body of the assembled rotor for each particular row of hammers. In FIG. **10**, a rotor drive means **530** is shown, removably but securely attached to the common shaft **500** at either end mounting pin **510**, **520**, respectively. The rotor drive means is preferably a belt pulley (most preferably a multi-belt pulley), or a cogged wheel for making contact with a drive pinion, or a splined flange with the splines arranged on its face for making contact with a drive wheel. The power to the rotor might be provided by a hydraulic drive, an electric motor or a mechanical drive unit, such as an internal combustion engine.

The attachment of the common shaft **500** to a rotor is preferably accomplished by attaching a conical bushing **540** to each end rotor body of a rotor, as shown in FIG. **11**. The conical bushing has a conical protrusion **545** and a central hole **546**, having a diameter which allows the conical bushing to be slidably fit over the common shaft **500**. A conical hole **565**, arranged either in each end rotor body or in a separate end piece fastenable to the end rotor body, is shaped to cooperate with the conical protrusion **545**. The conical bushing **540** further has fasteners **550** to securely fasten the conical bushing to fastening holes **560** in either the end rotor body or the separate end piece fastenable to the end rotor body. By fastening the conical bushing, the conical protrusion will be clamped in the conical hole and thus be pressed onto the common shaft, to securely clamp the common shaft to the conical bushing (and therewith to the rotor).

An alternative configuration of the hammers **200** of a rotor **600'** is shown in FIG. **9**A. Here, each hammer of a row of rotors **700'** is rotated a certain angle with respect to the hammers of an adjacent rotor body **100**, to form helical shaped rows of hammers. In this way, the efficiency of the shredding operation is enhanced, because the number of hammer hits per time unit is higher: each hammer hits the material to be shredded in sequence as opposed to simultaneously for the previous embodiment having straight rows of hammers. The embodiment is shown as having one hammer per rotor body, but any suitable number of hammers may be used per rotor body, to achieve a certain capacity of the comminuting mill etc.

A third embodiment of the interchangeable interface elements **200"** of the invention are shown in FIGS. **12** to **15**. The interchangeable interface elements have an impact end **240'** shaped like a knife, for cutting the material to be comminuted. The knife impact end cooperates with first shear surfaces **680** and second shear surfaces **670**, arranged in a housing **660** for holding the rotor assemblies **600'** of a comminuting mill according to a further embodiment of the invention, see FIGS. **14** and **15**. The housing further has bearing surfaces for holding the rotor assemblies in a rotatable way. In each rotor assembly **600'**, the rotor bodies **100** are assembled with distance elements **650** between two rotor bodies, to widen the area of interface element action.

It will be appreciated that the above description relates to the preferred embodiment by way of example only. Many variations on the invention will be obvious to those knowledgeable in the field, and such obvious variations are within the scope of the invention as described and claimed, whether or not expressly described. For example, the rotor bodies are shown having 4 cutouts, but any suitable number of cutouts may be used, ranging from 1 to a number dictated by the diameter of the rotor with respect to the size and dimensions of the interface elements used, see FIG. **16**, where 8 interface elements **200** are arranged in one rotor body **100'**. Also, the number of rotor bodies used to form a rotor assembly is shown as either **2**, **34** or **48**, but any suitable number of rotor bodies can be assembled to perform the required shredding operation. One standard size rotor assembly would be 24 rotor bodies wide, for example.

What is claimed as the invention is:

1. An interlocking interchangeable interface element and rotor assembly for rotary commuting mills, comprising:

at least two rotor bodies, a plurality of interchangeable interface element mounting cut-outs arranged substantially radially in said at least two rotor bodies and a plurality of peripheral mounting holes arranged to receive rotor body bundling means to hold said at least two rotor bodies fixedly against each-other and to prevent said plurality of interchangeable interface elements to exit from said interchangeable interface element mounting cut-outs, and a plurality of interchangeable interface elements arranged to be mountable in said interchangeable interface element mounting cut-outs, each of said plurality of interchangeable interface elements having:

a substantially oblong and generally flat shape having parallel flat sides;

a bottom end shaped to interlock with said interchangeable interface element mounting cut-outs;

a leading edge facing the direction of rotation of the rotors;

a trailing edge facing the side opposite to the direction of rotation; and where said interchangeable interface elements further have a bottom portion with a generally rounded surface arranged to cooperate with a generally rounded bottom portion of said interchangeable interface element mounting cutouts, a heel portion facing the direction of rotation and shaped to cooperate with a recess portion of said interchangeable interface element mounting cutouts so that during insertion of an individual interchangeable interface element in one said interchangeable interface element mounting cut-outs, by inserting said bottom portion first, the generally rounded surface is slidable past a protruding portion and into a relief recess portion of said interchangeable interface element mounting cut-outs, permitting said heel portion to clear said protruding portion and the interchangeable interface element to be seated with said bottom portion in said generally rounded bottom portion of said interchangeable interface element mounting cut-outs locking said individual interchangeable interface element from movement in a radial direction in said at least two rotor bodies, said plurality of interchangeable interface elements further having a first force absorbing surface, arranged on said trailing edge, and a second force absorbing surface, arranged on said leading edge, and interchangeable interface element securing fasteners, arranged to receive said rotor bundling means for securing said plurality of interchangeable interface elements to said at least two rotor bodies.

2. An interlocking interchangeable interface element and rotor assembly according to claim **1**, wherein each of said plurality of interchangeable interface elements further has interchangeable interface element tip mounting means, arranged in an upper mounting portion of each said plurality of interchangeable interface elements, for receiving interface element tips.

3. An interlocking interchangeable interface element and rotor assembly according to claim 1, wherein each of said plurality of interchangeable interface elements further has knife-shaped interface element tips.

4. An interlocking interchangeable interface element and rotor assembly according to claim 1, wherein said rotors have a substantially cylindrical outer edge.

5. An interlocking interchangeable interface element and rotor assembly according to claim 4, wherein said rotor bundling means comprise rotor bolts and rotor nuts.

6. An interlocking interchangeable interface element and rotor assembly according to claim 5, wherein said at least two rotor bodies are fixably arranged on a rotatable shaft running through central mounting holes in said at least two rotor bodies.

7. An interlocking interchangeable interface element and rotor assembly according to claim 6, wherein said at least two rotor bodies are attached to said rotatable shaft using a pair of conical bushings arranged to clamp said rotatable shaft to said at least two rotor bodies.

8. An interlocking interchangeable interface element and rotor assembly according to claim 6, wherein said plurality of interchangeable interface elements have replaceable interchangeable interface element tips arranged at an outer end of said plurality of interchangeable interface elements facing said leading edge.

9. An interlocking interchangeable interface element and rotor assembly according to claim 8, wherein said assembly comprises interchangeable interface elements arranged in straight rows.

10. An interlocking interchangeable interface element and rotor assembly according to claim 8, wherein said assembly comprises interchangeable interface elements arranged along helical curves.

11. An interlocking interchangeable interface element and rotor assembly according to claim 8, wherein said rotatable shaft is rotated by a hydraulic motor.

12. An interlocking interchangeable interface element and rotor assembly according to claim 8, wherein said rotatable shaft is rotated by an electric motor.

13. An interlocking interchangeable interface element and rotor assembly according to claim 8, wherein said rotatable shaft is rotated by an internal combustion engine.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 6,364,227 B1
DATED : April 2, 2002
INVENTOR(S) : Dorscht

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Title page,
Item [*] Notice, delete the phrase "by 0 days" and insert -- by 17 days --

Signed and Sealed this

Ninth Day of November, 2004

JON W. DUDAS
Director of the United States Patent and Trademark Office